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Technical information for private, trunked and public safety networks.

MAY 2000

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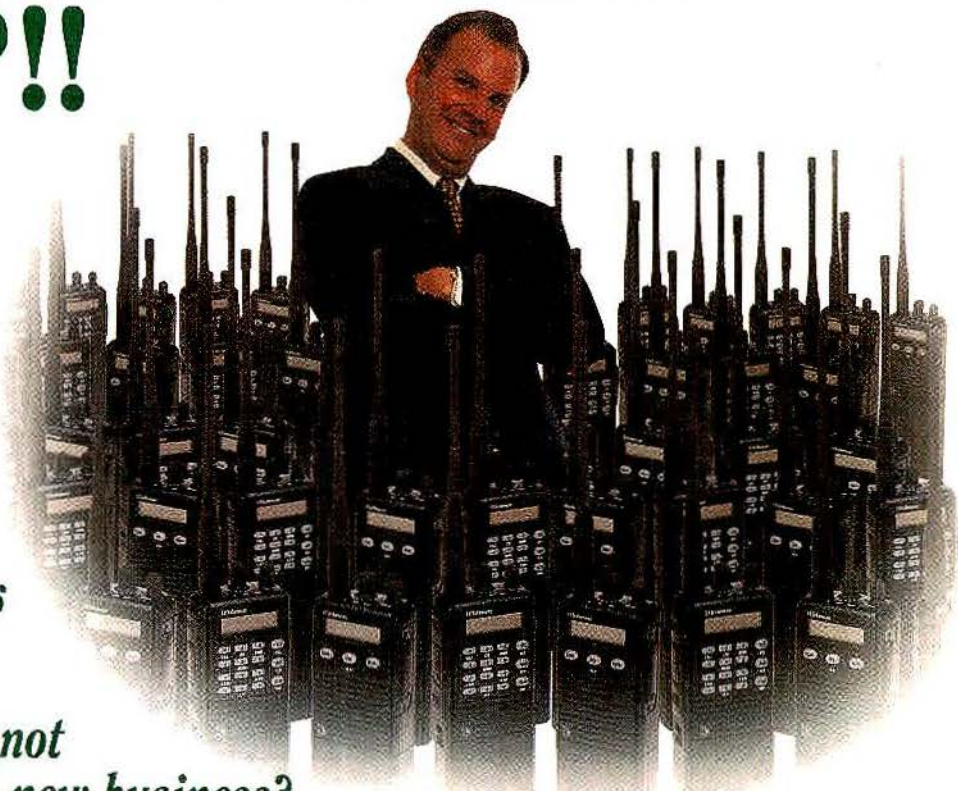
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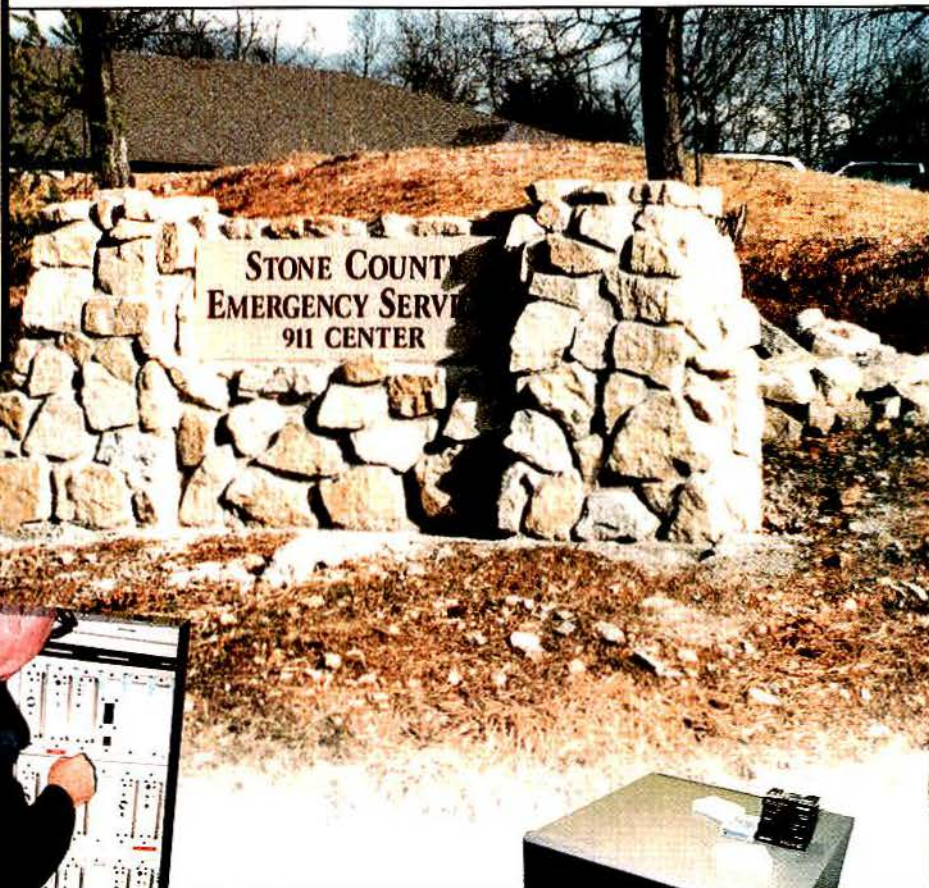
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MOBILE RADIO TECHNOLOGY

May 2000



**On the cover:** With the implementation of 9-1-1, Stone County, MO, constructs a state-of-the-art dispatch center. See the story on page 26. Cover design by Scott Dolash, art director. Photography by Nikki Chandler.

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## FM resurges; will contenders convert the faithful?

### Conventional? Good news ...

Manufacturers want to sell large two-way radio communications systems, and the bigger, the better. The largest contracts involve big cities, or several cities together; large counties, or several of them together; statewide systems; and for the federal government, regional or nationwide systems. Most involve central-controller trunking, mostly at 800MHz.

Many of these sales go to the usual players—Motorola, Com-Net Ericsson and E. F. Johnson. A relative newcomer, the AMP division of M/A-Com, landed Pennsylvania's contract.

Yet, an estimated 75% or more of the public safety agencies use conventional VHF equipment. Plus, hundreds of thousands, if not a few million, business and industrial customers use conventional VHF and UHF equipment.

Manufacturers have shown a renewed interest in VHF and UHF conventional equipment, and that should be encouraging to dealers because they sell a large portion of it.

At the International Wireless Communications Expo trade show (owned by our publisher, Intertec Publishing), Motorola rolled out new conventional products in what one of its senior product managers, Craig Chenicek, said culminates the company's first complete look at conventional two-way radio products in 10 years. Com-Net Ericsson Critical Radio Systems, the fresh new owner of the former Ericsson Private Radio Systems, continues the rollout of new conventional products that began a year ago.

We don't discount the efforts of smaller manufacturers. Kenwood Communications, for example, through its Kenwood Systems unit, builds conventional and trunked systems for public safety, business and industrial customers. What we're saying is that the investment by large manufacturers in upgraded conventional products puts money behind the notion that small customers, in large numbers, will continue using private radio communications.

### Spectrum efficiency choices

Intek Global became the Securicor Wireless subsidiary of Securicor, Surrey, United Kingdom, in August 1999.

The company since has placed the Securicor Wireless brand on its radio, AVL, data and network products. Securicor Wireless offers spectrum-efficient "linear modulation" (LM) products with MPT 1327-style trunking.

Datamarine International's SEA subsidiary offers spectrum-efficient, "amplitude-companded sideband" (ACSB) products with distributed logic trunking.



ComSpace's "digital channel, multicarrier architecture" (DCMA) products work with conventional two-way radio and all trunking protocols.

Securicor Wireless products offer AVL, vehicle status and low-volume mobile data at a competitive price, instead of promoting voice communication as a primary feature.

ComSpace products let FM trunked systems migrate to a capacity-multiplying digital mode, one channel at a time. More recently, ComSpace has promoted voice quality and advantages for soon-to-be-available "packet data" for data applications.

The Securicor Wireless network rollout goes slowly. Yet, the company has important customers, such as utility members of its spectrum licensing partner, the National Rural Telecommunications Cooperative. (SEA has similar utility customers.) In March, Securicor Wireless added Sunrise, FL-based Marketronics as a customer that will build an LM network in southeastern Florida and perhaps in selected Latin American countries.

ComSpace isn't announcing customers until its products are FCC type-accepted, beta-tested and ready. Mean-

while, it inked an OEM agreement with Hitachi Denshi that gives ComSpace the Tokyo company's enormous manufacturing capacity. It adds Hitachi Denshi's product engineering expertise to ComSpace's current team, headed by its executive vice president and chief technology officer, David George.

Much has been said about how spectrum-efficient radios will rescue business, industrial and commercial land mobile radio in a time when additional allocations by the FCC go to everyone else.

Outside of 220MHz, most of the progress in spectrum efficiency has involved FM two-way radios with narrowed deviation to fit 12.5kHz channels, instead of the previous 25kHz channels. That's a potential 2:1 improvement, depending on whether the adjacent 12.5kHz channels can be used without interference. LM promises as much as a 6:1 improvement, and DCMA promises as much as 8:1.

In the 220MHz band, and to a limited extent at VHF highband, 5kHz LM and ACSB networks have been built.

In addition to supplying itself with network infrastructure and selling mobiles to its own subscribers, Securicor Wireless sells infrastructure and mobile units to other network operators. SEA has pursued a similar strategy, although its network build-out through its Narrowband Network Systems subsidiary has only limited operations. ComSpace has no plans to operate networks and wants other manufacturers to make DCMA subscriber units and, eventually, repeaters under a technology license.

First ACSB and then LM had turns as fresh, new golden prospects for placing large numbers of spectrum-efficient units with subscribers. They haven't yet displaced FM, but mostly because regulatory obstacles kept them from competing as effectively as they might have. DCMA will take its turn as the next golden prospect, and it doesn't seem to face the same regulatory hurdles as it steps up to the task of converting the faithful from FM.

don\_bishop@intertec.com

*Don Bishop*

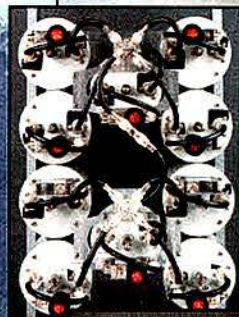


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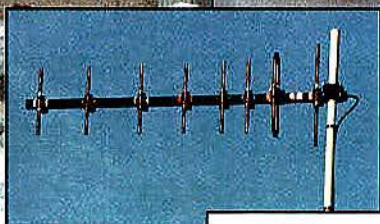
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**FEATURES:** Crystal filters; Wireless@Work; aircraft manufacturing; dealer topics; public safety news roundup; product/services showcase.

**PLUS:** Robert H. Schwaninger Jr.'s "In the Public Interest"; Harold Kinley's "Technically Speaking"; David Dunford's "Public Safety: 10-2"; editorial commentary from Don Bishop and Ramona Isbell; Product focus—what's new in power supplies.

### AND IN THE MONTHS TO COME:

Interconnection; APCO pre-show; portable radios; installing equipment mounts; mobile radios.

Wireless at work:

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**8-11: Telecommunications Resellers Association Spring Conference and Exposition**, Philadelphia Marriott. Contact: 202-835-9898 or [www.tra.org](http://www.tra.org).

**9-11: BAPCO 2000**, sponsored by the British Association of Public Safety Communications Officers, Novotel Exhibition and Conference Centre, Hammersmith, London. Contact: +44 1522 57552 or [www.bapco.org.uk](http://www.bapco.org.uk).

**15-18: Spring Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Hotel Pacific Tokyo, Tokyo. Contact: +81468-40-3552 or email [matumoto@mars.yrp.nttdocomo.co.jp](mailto:matumoto@mars.yrp.nttdocomo.co.jp).

**17-19: Site Owners & Managers Alliance (SOMA) Conference**, sponsored by the Personal Communications Industry Association, Kansas City, MO. Contact: [www.pcia.com](http://www.pcia.com).

**18-19: APCO Symposium Series—Wireless E9-1-1**, sponsored by the Association of Public Safety Officials—International, Chicago. Contact: [www.apcointl.org/conference/2000/wireless.htm](http://www.apcointl.org/conference/2000/wireless.htm).

**30-June 1: Canadian Wireless**, sponsored by the Canadian Wireless Telecommunications Association, Toronto. Contact: 613-233-4888, ext. 102, or [www.cwta.ca](http://www.cwta.ca).

### June

**4-8: Supercomm**, sponsored by TIA and USTA, Georgia World Congress Center, Atlanta. Contact: 800-278-7372.

**12-13: AMTA Leadership Conference and Annual Meeting**, sponsored by the American Mobile Telecommunications Association, Sheraton Suites, Alexandria, VA. Contact: 202-331-7773 or [www.amtausa.org](http://www.amtausa.org).

**18-21: NSA 2000 Conference**, sponsored by the National Sheriffs' Association, Kansas City, MO. Contact: 800-424-7827, ext. 321.

**25-29: UTC Telecom**, sponsored by UTC, The United Telecom Council, Phoenix. Contact: 202-857-1881 or [www.utc.org](http://www.utc.org).

### July

**16-19: Forestry Conservation and Communications Association National Conference**, Elms Resort & Spa, Excelsior Springs, MO. Contact: 573-751-4115, ext. 172.

### August

**13-17: Association of Public-Safety Communications Officials—International (APCO) National Conference**, Boston. Contact: 904-322-2500 or [www.apco2000.org](http://www.apco2000.org).

### September

**19-22: Fall Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Seaport Hotel, Boston. Contact: 904-322-2500.

**26-29: PCIA GlobalXChange**, sponsored by PCIA, McCormick Place, Chicago. Contact: 703-739-0300 or [www.pcs00.com](http://www.pcs00.com).

### October

**4-7: Private Wireless Spectrum Management Conference**, sponsored by the Industrial Telecommunications Association, the Council of Independent Communication Suppliers and USMSS.

Grand Hyatt Hotel, Washington. Contact: Ray Wisniewski, 703-797-5123 or email [ray@ita-relay.com](mailto:ray@ita-relay.com).

**23-25: AMTEX**, sponsored by the American Mobile Telecommunications Association, Embassy Suites Outdoor World, Dallas. Contact: 202-331-7773 or [www.amtausa.org](http://www.amtausa.org).

### November

**12-15: Telecommunications Resellers Association Fall Conference and Exhibition**, sponsored by TRA, Anaheim, CA. Contact: 202-835-9898 or [www.tra.org](http://www.tra.org).

**15-18: Communications Marketing Conference**, sponsored by the Communication Marketing Association, Sheraton Colony Square, Atlanta. Contact: 404-892-2600, ext. 300 or [www.commktga.com](http://www.commktga.com).

## 2001

### January

**6-9: International CES**, sponsored by the Consumer Electronics Manufacturers' Association; Las Vegas Convention Center, Las Vegas Hilton, Riviera Hotel and Alexis Park Hotel, Las Vegas. Contact: [www.CESweb.org](http://www.CESweb.org).

### March

**20-22: Wireless**, sponsored by the Cellular Telecommunications Industry Association, Las Vegas. Contact: 202-785-2842 or [www.wow-com.com](http://www.wow-com.com).

**20-23: NATE**, sponsored by the National Association of Tower Erectors, Adam's Mark Hotel, Dallas. Contact: 214-922-8000 or [www.natehome.com](http://www.natehome.com).

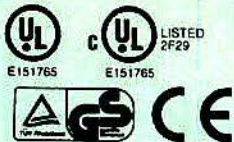
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MODEL SS-12IF



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SS-30	25	30	3 1/4 x 7 x 9 1/2	5.0

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MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SS-25M*	20	25	2 1/4 x 7 x 9 1/2	4.2
SS-30M*	25	30	3 1/4 x 7 x 9 1/2	5.0

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MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25	20	25	3 1/2 x 19 x 9 1/2	6.5
SRM-30	25	30	3 1/2 x 19 x 9 1/2	7.0

## WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25	20	25	3 1/2 x 19 x 9 1/2	6.5
SRM-30	25	30	3 1/2 x 19 x 9 1/2	7.0

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MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25A-2	20	25	3 1/2 x 19 x 9 1/2	10.5
SRM-30A-2	25	30	3 1/2 x 19 x 9 1/2	11.0

## WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M-2	20	25	3 1/2 x 19 x 9 1/2	10.5
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SS-10SM/GTX, SS-12SM/GTX, SS-18SM/GTX  
SS-10RA  
SS-12RA  
SS-18RA  
SS-10SMU, SS-12SMU, SS-18SMU  
SS-10V, SS-12V, SS-18V

Circle (8) on Fast Fact Card





## Growing stronger on what's ignored

IWCE 2000 is over, but not all the business lessons were delivered at the show. Ignoring admonitions of friends and co-workers about damaged luggage, over-bookings and flight delays, I flew to and from Las Vegas on a Phoenix-based airline that I'll just refer to as "A.W." Sure enough, all four trip legs were over-booked, and the planes never left a terminal until every seat was crammed with human cargo. The delay leaving Phoenix for Las Vegas was longer than the actual

flying time. When belted into a space smaller than the average coffin, with no fresh air forthcoming and the sun beating down, people get a little testy.

What really irritated my seat mate and myself was at no point did the crew attempt to explain the delay or even apologize for the inconvenience. The flight attendants refused to even acknowledge his request for an update—they walked right past him. Well, the nice thing about being a consumer is that you can vote with your feet.

Complaints led to conversation. I discovered that my companion was a service provider and dealer also bound for IWCE. Inquiries about his business revealed that he had recently gained a substantial, nationally known customer because a certain ESMR entity had dropped the ball. The ESMR determined that revenues from one of three sites serving this customer, over a broad geographic area, weren't up to the expectations of the "bean counters." The ESMR sent a form letter announcing deactivation of that site. (When the system was built, the site was one of two secondary sites supporting the primary near the customer's home base. When the ESMR took over, it averaged anticipated returns over all three sites.) The customer called my companion to ask if he was interested in providing SMR service. He jumped on it, and it should become a six- or seven-figure account. The customer voted with its feet.

Proactively seeking prospective clients (*see this issue's feature on Racom Corporation*) is another way to capitalize on customer dissatisfaction. Don't just wait for the phone to ring. Find the businesses unhappy with their service, and let them know how your approach to customer service, as well as your pricing, differentiates you.

Business consulting guru Tom Peters once said "It is my principal, prime conclusion, whether your business is jet engines or whether it's peddling hamburgers, that if you simply treat your customer with common, ordinary, garden-variety *courtesy*, you can have the 'lion's share' of any market that you want—because you'd be *alone*."

—D. A. Keckler  
Features Editor

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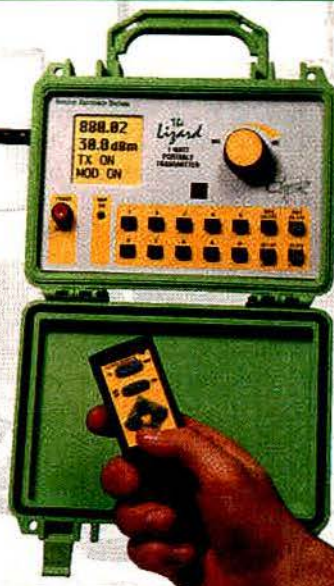


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# A marriage made in 47 C.F.R.

By Robert H. Schwaninger Jr.

Almost 20 years ago, I graduated from law school, packed everything I owned into a U-Haul, drove across the country from Missouri to Washington, DC, and started looking for a job with a telecommunications law firm. It took about nine months of courting, but eventually I was swept into the industry on the cellular wave, like a lot of then-young lawyers.

During the first few years, I mainly listened. I would visit the offices of FCC engineers and get them to answer my questions about propagation, dumb lawyers, dumber bureaucrats and dumbest politicians. I got to know and respect form processors, file room folks and a host of other workers at the FCC. And I privately shared their frustration with their jobs, while I tried to figure out what the heck I was doing.

Eventually, I got the hang of this job and began to dance with some lower-level politicians at the agency: branch chiefs, assistant bureau chiefs and (eventually) real, live *commissioners*. The higher toward the top floor that I ventured, the more time I invested in understanding this regulatory "creature." Over time, I discovered that my future was tied to this living body called the FCC.

Over the years, we've grown comfortable together, the agency and me. Although it often is a marriage made in hell, the whole thing reminds me of a long episode of "The Honeymooners," with me playing the role of Ralph (and sometimes Norton). The fights are the stuff of comedy, and the insults, jabs, and vein-popping

Schwaninger, *MRT's* regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a member of the Radio Club of America.

invective keep it interesting. But the old gal and I continue on, and we probably will for a long time.

## Marriage counseling needed

As with all marriages, ours (the FCC's and mine) takes a lot of work. We



Illustration by John Hayes

often don't see eye to "black" eye. The commissioners and staff think that I'm too critical, while I think they're too controlling. I want them to help more with the kids, while they just want to play with their special friends. I believe that harmony is better than vanity, and I don't care if we keep up with the neighbors. The list goes on.

If we were to go to marriage counseling, there are a lot of things that I would say to my "life partner." For example:

► *Just say it* — What's so hard about that? Instead, you bury your meanings in interpretations, legal precedent, outdated legislation and the vagaries of multiple reports and orders, rather than consolidating a body of rulemaking into a single document. Why? Can't you just say what you mean and not make me guess?

► *Make it work* — You know, FCC, old girl, it would be really terrific if your vaunted theories worked in the real world. Let me give you a few facts for future efforts. First, all operators aren't rich. Second, all equipment does not work with all other equipment. Third, changing frequencies, bandwidth, ERP, service area and a variety of other stuff that has to do with wireless communications can't be done with the twist of a screwdriver. Fourth, the industry is not entirely concerned with the global marketplace; many operators are simply trying to pay their mortgages.

► *Look away from the mirror* — I know this might be hard to take, but it's not all about *you*. Sometimes you have to look to see what the public needs, wants and can afford. You might want to check your processes, forms and electronic gizmos to see if they make the process better for your customers, not just for your staff and administrative functions. Sometimes a little customer service would be better than sewing drapes for another electronic window.

► *Could you listen?* — You simply don't *listen*.

People file comments, write letters and give suggestions, but their input rarely shows up in your decisions. Being a government agency is about being responsive to the needs of people, not publicly traded corporations alone. Try to listen more, even if you don't always like what is being said.

► *Please, don't lie* — You may call it a mistake or an omission or something else, but we all know it's a *lie*. And you do it so often that I think that you've lost



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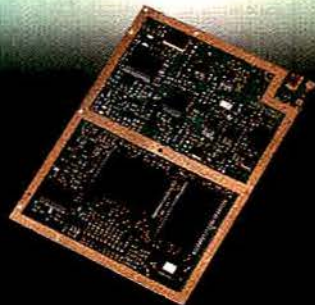
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sight of the truth. Ask yourself whether you are spending a lot of time writing a decision so that it will hold up under scrutiny if it's left to your own discretionary authority. If you have to keep relying on interpretations and discretion, then you are likely blowing smoke.

► *Fix it* — If you blow it, *fix* it. If a decision is found to be wrong, admit it, change it and try to repair whatever damage the original decision caused. As important as it is for you to be honest in the first instance, it is also important for you to be willing to accept responsibility when a decision was wrong. Remember, even the cheapest car has a reverse gear.

I could go on ... and on ... and on

But what's the point? You're gonna do what you're gonna do, aren't you? And I'm too invested in this relationship to just leave. Besides, there are too many people depending on me to try to talk a little sense into you. And, after all, it's not all your fault.

Congress has historically underfunded you. Your household budget has never really kept up with the bills. You've had to cut corners, make excuses and go without. Now you're trying to use computerized time-saving devices to do the cleaning and the cooking that you just can't keep up with. But food from the microwave just isn't as tasty as slow-roasted, and the results are tangible. The flavor that we sometimes call "the public interest" just isn't there anymore, and the dishes are quick and bland.

I'm hoping our relationship will improve—not in speed or quantity, as much as in quality. It would be nice if we could *talk* again, without the need for intermediaries and judges. The world would be better if you would come out from behind the sofa and see what's on the other side—a country filled with caring individuals who would like to get to know you better and to understand why you feel it necessary to always say, "Bigger is better."

Baby, you *ain't* the greatest

If we were actually "The Honey-mooners," Ed Norton would drop in and give us a much-needed laugh. But you're not Alice, and I'm not Ralph. The only thing funny about *this* marriage is that the community property of spectrum is being given away to your rich relatives, who don't need it, won't make a profit by owning it and will only parade it to sell shares of stock to unwitting investors.

Funny, isn't it? Or maybe it's just sad. ■

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## Pogo lives in public safety

*We have met the enemy—and he is us.*

By David O. Dunford

First, my thanks to the *MRT* staff for their hospitality during the recent IWCE. Even though I've attended APCO conferences for years, this was my first IWCE, and it was great!

I'm really encouraged by the combination of technical savvy and business acumen demonstrated by so many of the attendees. I was also glad to learn from Robert Schwaninger's opening remarks that attorneys and radio guys will be the ultimate post-nuclear survivors.

On a more serious note, and on careful reflection (the mental kind, not the mirror kind), my concerns regarding public safety communications were reinforced by observations made at the show. Instead of stimulating and leading technological development and revolution in communications, public safety is, at best, only "along for the ride." At worst, we are lagging in development. At the "very worst," we're lagging so far back that we could be stationary.

What's the deal? How could this happen? How could something as essential, vital, critical and important as public safety communications be so deftly and effectively ignored? (Fortunately, in this column we not only raise the questions, but try to offer the answers to the readers as well.) Simply put, the issue is not indifference—it's *money*. And circumstances. And people.

It appears to be one of those simple math problems, the answer to which is "the null set" (Mr. Smith's algebraic functions class in eighth grade). As a leading-edge consumer of communications technology, the government is lagging in response and will continue to lag. And so high-tech development is held back by virtue of government's organization, function and purpose. (This is shaping up as being a really depressing topic, isn't it? But as my friend Steve "Grumpy" Davidson says, "Everyone is entitled to my opinion.")

By its nature, the heart of government organization works to be accountable and reactively responsible, typically providing services and organizational functions not specifically suited to the competitive private sector. We are not

chartered, or charged, to be profitable, inventive or adaptive. (Many units of government, especially within smaller entities, are an exception to this generalization, but their success is often the reaction to fiscal constraints.)

What does all this mean for the communications realm? Here's the *money* part: For most governmental agencies to embark on a technology replacement or enhancement program whose cost exceeds some threshold value (\$50K–\$100K), that agency must program the expenditure into a planned capital improvement program (CIP). The CIP is scheduled and reviewed by (and typically requires the approval of) the governing body (city council, county government, state legislature, etc.). Even though technology projects are frequently being pushed toward the top of the list, each department or agency must still compete for capital funds with all other high-dollar (read: photo-opportunity and voter-pleasing) projects.

Because CIP dollars are subject to a variety of forces external to the agency (read: vagaries of financial markets), the effect is predictable. Major capital expenses must be programmed years in advance and may be protracted even after budgeted. We plan for and program project money based on known costs today, but the only factor really known is *today's* perspective of the cost/performance formula.

When purchasing high-technology communication systems, the quandary is that future capabilities will be far greater, and specified vastly differently, than we comprehend today. Simply put, the system buyer has to ask for money today for yet-unknown equipment, to be purchased at an unknown price sometime in the future, for needs that haven't evolved yet. Because these system replacement projects use up "political" capital as well, all these future unknowns could lead the agency executive to think seriously about entering the private sector job market.

So how is a sale made? In an effort to accommodate this protracted and convoluted purchase process for large agency systems (which are replaced only once every 15, 20 or 25 years), the major manufacturers retain "black box" and "gadget-based" hierarchy systems. They

are, in essence, responding to the market needs (read: ours) for a clear, finite, product-evolution approach. Portables should remain the same, but they should be smaller. Mobiles should remain basically the same, but they should become more intelligent—and have alphanumeric heads. Base stations should remain basically the same, but they should be smaller, run cooler and be "digital." Pagers should be smaller, do more—and have colored housings.

The real problem is that public safety needs are actually driven by other contemporary technologies, not just by the "radio system." Yet, traditional major manufacturers (insert your favorite vendor's name here) retain, endorse and promote *s-l-o-w* system evolution paths that actually perpetuate the traditional purchase process—and they do so at substantial cost. The result is that we get new gadgets, not new *capabilities*. This is the *circumstances* part.

The *people* part involves the maintenance system currently used by system operators. Technicians and engineers servicing public safety customers often continue to support products and systems long after that equipment "should be" worn out. I believe this is done out of respect and commitment to the affected agencies. But the effect of this protective caretaking is that the agencies themselves (us, again) have come to believe that any new system may not "really" be needed. After all, "the techs have been doing a fine job of keeping us up and running."

So, the purchase process is too slow, the new equipment isn't really distinctly different and our techs already do a great job keeping up the "old stuff." What chance does change have in public safety?

Here are some observations for your consideration: Public safety has an established relationship with technical providers—either via equipment purchases or maintenance and support—that will grow. As more aspects of high-tech communications are adopted by public safety (albeit through commoditized, consumer-type equipment), technical support must expand. With active, creative participation by local service providers, it could explode. ■

Dunford, *MRT's* public safety consultant, is manager of technical services for the Lenexa, KS, police department. He is a member of the Radio Club of America and a member and past president of the Kansas Chapter of the Association of Public-Safety Communications Officials—International. You can email Dunford at [mrt@intertec.com](mailto:mrt@intertec.com).



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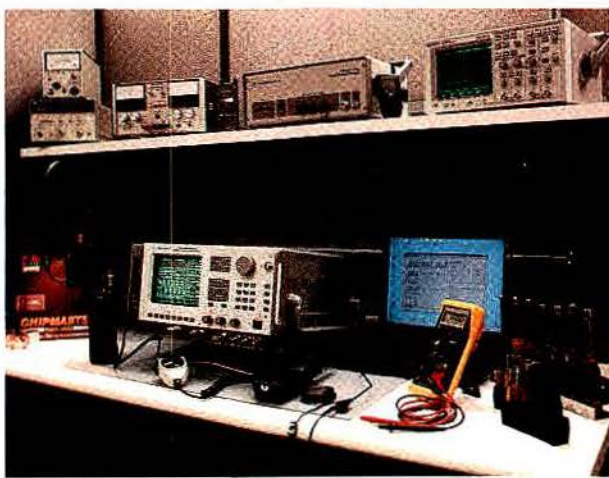
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## Signal-to-noise ratio

By Harold Kinley

One of the most fundamental principles in radio is that of signal-to-noise ratio (SNR) at various stages of a receiver chain. Factors such as receiver noise figure, antenna site noise, transmission line attenuation, antenna gain and directivity, transmitter output power and propagation all play a major role in determining the ultimate SNR at the input to a receiver. The noise figure of the receiver *might* play a major role in the final SNR at the *audio output* of the receiver. Let's examine how some of these factors affect the SNR at the receiver.

SNR can be defined by the simple mathematical expression shown below:

$$\frac{\text{Signal}}{\text{Noise}}$$

From this simple mathematical

expression, it is clear that to improve the SNR we must *increase* the signal level, *reduce* the noise level or do both. Often, neither is easy, nor simple, to achieve.

### Noise figure

The noise figure of a receiver may or may not have a significant impact on how the receiving system performs at a particular location. Let's look at the equivalent noise input to a receiver. First, let's take a 50Ω resistor and calculate the amount of noise voltage ( $E_n$ ) at the open-circuited output terminals of the resistor. The formula for calculating this is:

$$E_n = \sqrt{4kTB R}$$

The  $k$  represents a constant of  $1.38 \times 10^{-23}$ . The  $T$  represents temperature, in degrees Kelvin. (Usually, 290°K is used for the temperature. This is equivalent to about 63°F, or 17°C.)

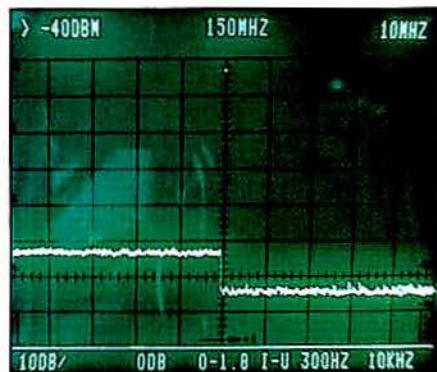


Photo 1. This spectrum analyzer display demonstrates that noise level is a function of the bandwidth of the receiver. Here, as the sweep was moving across the screen, the resolution bandwidth was switched from 100kHz to 10kHz. As shown on the screen, the noise level dropped by 10dB (see middle of screen).

$B$  represents bandwidth in hertz, and  $R$  represents resistance in ohms.

The noise voltage in a 1Hz bandwidth would be:

$$\begin{aligned} &\sqrt{4 \times 1.38 \times 10^{-23} \times 290 \times 1 \times 50} \\ &= 8.9465076 \times 10^{-10} \\ &= 0.00089465076 \mu\text{V} \end{aligned}$$

Figure 1 at the left represents the resistor noise voltage by using a 50V signal generator. In Figure 1A, the output is open-circuited. In Figure 1B, the resistor is connected across the input to a receiver with a 50V input impedance. The noise voltage appearing across the receiver input is half the open-circuited noise voltage. Thus, the noise voltage across the receiver input is 0.000447325mV. This is equivalent to 2174dB, which is an important figure to remember. It means that in a 50V impedance, the noise floor at the input to a receiver with a noise figure of 0dB in a 1Hz bandwidth is 2174dBm. If we increase the bandwidth of the receiver by a factor of 10, then the noise floor increases by 10dB to 2164dBm. Compared to a bandwidth of 1Hz, the correction factor for other bandwidths is:

$$N = 10 \log B$$

Contributing Editor Kinley, MRT's technical consultant and a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual, with Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewyld Drive, Spartanburg, SC 29301.

Kinley's email address is [hkinley@home.com](mailto:hkinley@home.com).

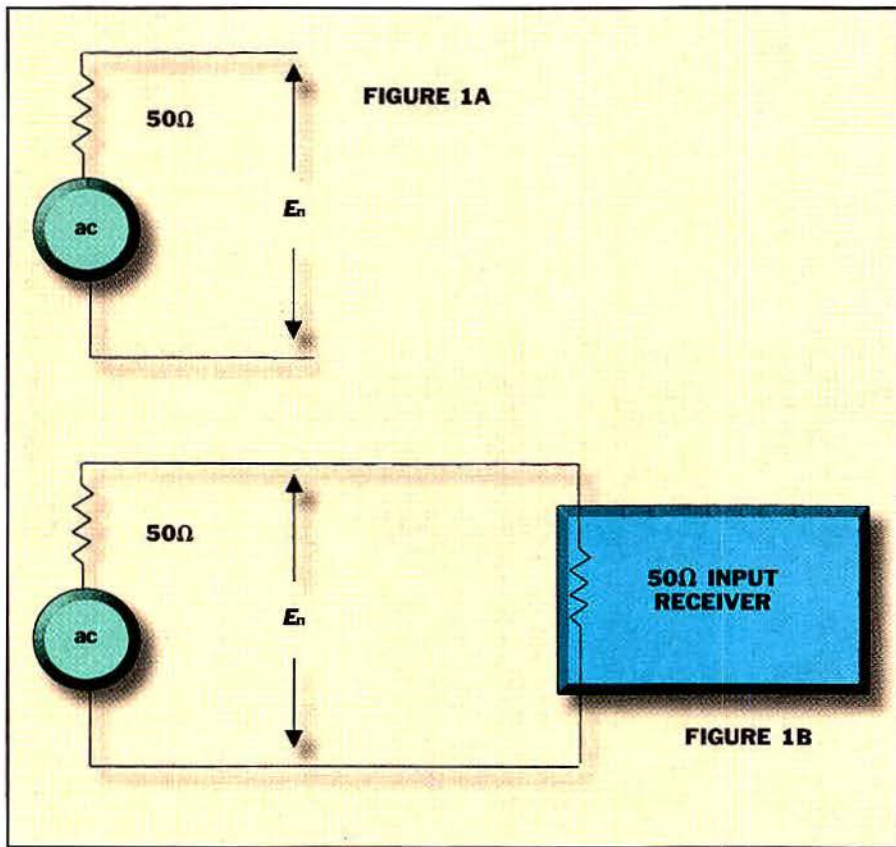


Figure 1A. The noise generated in the 50Ω resistor is represented as a generator in series with a 50Ω resistor. The open-circuit noise voltage,  $E_n$ , appears across the output terminals. Figure 1B. The resistor is connected across the receiver with a 50Ω input impedance. Only half of the noise voltage generated in the resistor appears across the input to the receiver because of the voltage divider action.



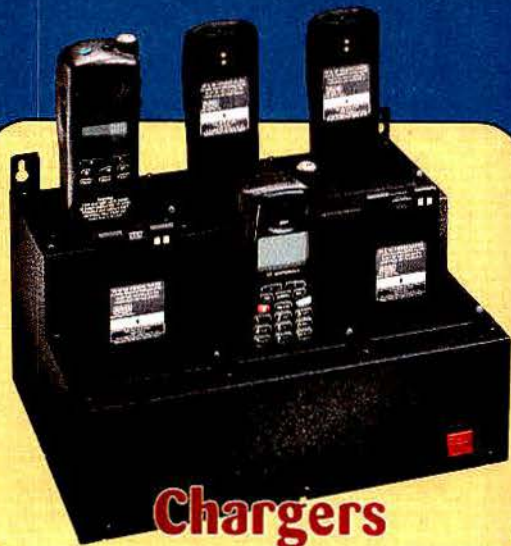
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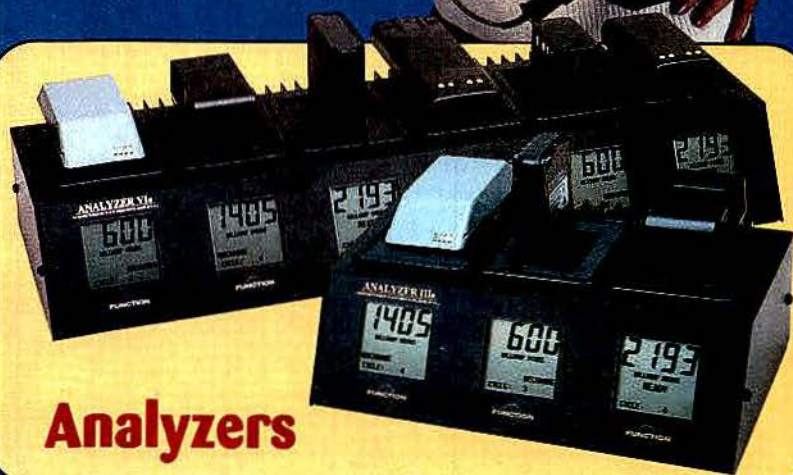


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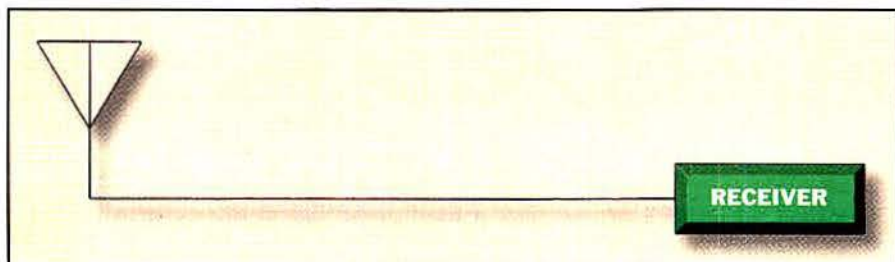


Figure 2. A typical receiver chain. The antenna is a unity-gain (0dBd) type. The transmission line has a 2dB loss. The receiver has a sensitivity of  $0.3\mu\text{V}$ , or  $-117\text{dBm}$ . The noise floor of the receiver is  $-121\text{dBm}$ , making the receiver noise figure  $11.24\text{dB}$ .

where  $N$  is the noise floor correction bandwidth in hertz. (See Photo 1 on page 18.)

For a typical, narrowband ( $\pm 5\text{kHz}$  deviation) FM receiver, the bandwidth would be about  $15\text{kHz}$ . The correction factor for  $15\text{kHz}$  would be  $10\log 15,000$ , or  $41.76\text{dB}$ . Thus, for a receiver with a noise figure of  $0\text{dB}$ , the noise floor would be  $-174 + 41.76$ , or  $-132.24\text{dB}$ . Again, this is for a receiver with a noise figure of  $0\text{dB}$ . The noise floor of a typical, narrowband FM receiver is about  $4\text{dB}$  below the  $12\text{dB}$  SINAD sensitivity of the receiver. For example, suppose the  $12\text{dB}$  SINAD sensitivity of the receiver is  $0.3\mu\text{V}$ , or  $-117\text{dBm}$ . Then, the noise floor of the receiver is  $-121\text{dBm}$ .

Because this is  $11.24\text{dB}$  worse than a receiver with a  $0\text{dB}$  noise figure [ $-121\text{dBm} - (-132.24\text{dBm})$ ], this receiver is said to have a noise figure of  $11.24\text{dB}$ .

It is interesting to note that once the RF input signal level is increased by about  $4\text{dB}$  above the noise floor of the receiver, the audio output of the receiver can produce  $12\text{dB}$  SINAD. (This was checked against several references and with a design engineer. It is a questionable point to ponder, but the experts say it is true.)

Remember that the receiver noise figure *may* or *may not* have a significant impact on how the *receiving system* performs at a particular site. "Receiving system" means all of the components that make up the receiver chain. The receiver itself will be considered as a single component of the chain—not broken down into subsystems such as mixer, IF amplifier, etc. A few examples will illustrate, using various situations and receiver chains.

#### Example 1

Figure 2, above left, shows a typical base station installation that is simple and straightforward. The antenna is a unity-gain ( $0\text{dBd}$ ) type. The transmission line has a loss of  $2\text{dB}$ . The receiver sensitivity is  $0.3\mu\text{V}$ . The noise voltage induced into the antenna from surrounding (near or far) noise sources is at a level of  $-125\text{dBm}$ . The desired signal voltage appearing across the antenna terminals at the coaxial cable connection is  $1\mu\text{V}$ . Converting the  $1\mu\text{V}$  signal to decibels referenced to  $1\text{mW}$  ( $\text{dBm}$ ) yields a signal level of  $-107\text{dBm}$ .

The signal from the antenna is attenuated  $2\text{dB}$  by the transmission line and is reduced to a level of  $-109\text{dBm}$  at the receiver input. The noise induced into the antenna is also attenuated  $2\text{dB}$  by the transmission line and appears at the receiver input at a level of  $-127\text{dBm}$ . As long as the noise contributed by the

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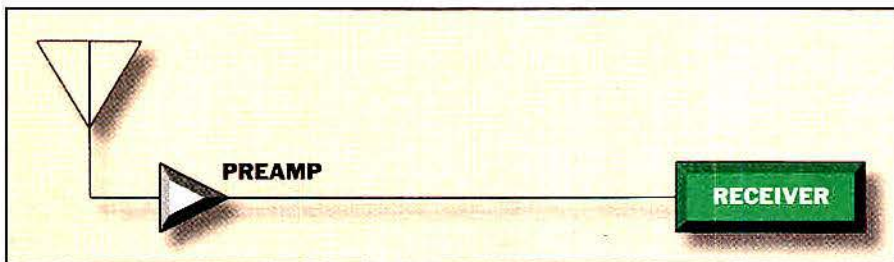


Figure 3. This is the same setup as in Figure 2, except that a tower-top preamplifier has been added. The preamplifier has a noise figure of 2dB and a gain of 15dB.

antenna is several decibels greater (at the receiver input) than the receiver noise floor, the antenna-contributed noise will be the predominant noise, and the receiver noise can be ignored for practical purposes. In this case, the receiver noise floor is  $-121\text{dBm}$ . So the noise contributed by the antenna and present at the receiver input is  $6\text{dB}$  below the level of the receiver noise floor. In this case, the receiver noise is the predominant noise.

The total noise at the receiver input can be determined by finding the *root-sum-square* of the *antenna-contributed noise* and the *receiver-contributed noise*. Because the antenna-contributed noise at the receiver input is  $-127\text{dBm}$ , or  $0.1\mu\text{V}$ , and the receiver-contributed noise is  $-121\text{dBm}$ , or  $0.2\mu\text{V}$ , the total

noise at the receiver input is:

$$\sqrt{0.1^2 + 0.2^2} = \sqrt{0.05} = 0.2236\mu\text{V}.$$

A level of  $0.2236\mu\text{V}$  is equal to  $-120\text{dBm}$ . So, the SNR at the receiver input is  $11\text{dB}$  [ $-109 - (-120)$ ]. If the minimum required SNR is  $10\text{dB}$ , then this situation would just meet the minimum requirements.

#### Example 2

On certain days, due to poor propagation conditions, the signal at the antenna terminals drops by about  $5\text{dB}$  to a level of  $-112\text{dBm}$ . Assuming the noise level remains the same at the antenna site, this will produce a signal level of  $-114\text{dBm}$  at the receiver input and a noise level (antenna-contributed) of  $-127\text{dBm}$ . From the calculations in the

first example, we know that the noise level at the receiver input is  $-120\text{dBm}$  because the noise level at the antenna did not change.

Now, the signal level at the receiver input will be  $-114\text{dBm}$ , resulting in a SNR of  $6\text{dB}$  at the receiver input. This is far below the required SNR and will produce a noisy signal at the audio output. What can be done to improve the situation? It depends on several factors. If this is a fixed point-to-point link between two base stations, then the power of the transmitters might be increased. This would require a quadrupling of the transmitter power on each end (assuming both ends are affected equally by deteriorating propagation conditions). Increasing antenna gains, or using directional antennas, might provide the necessary increase in signal level. What about a tower-top preamplifier at the site? In the next example we will add a preamplifier and calculate the results.

#### Example 3

With everything else the same as in the previous example, we add a tower-top preamplifier to the receiving chain, as shown in Figure 3 above. The noise figure of the preamplifier is  $2\text{dB}$  and the gain is  $15\text{dB}$ . Let's calculate the results

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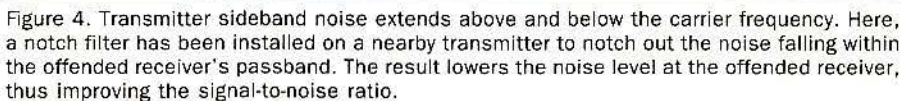
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You might have noticed that we ignored the 2dB noise figure of the preamplifier because the SNR at the



the output of the preamplifier, it would not have been as much as 2dB.

Suppose that the signal level is good, but the noise level on the site has increased such that the SNR is seriously degraded. This will cause the weaker signals to be lost in noise and to become

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unreadable. One typical cause of such an increase in noise level is transmitter sideband noise. Such noise occupies a wide bandwidth and can seriously impair "effective" receiver sensitivity. Nothing can be done at the affected receiver to mitigate the problem. The solution lies with the offending transmitter.

Suppose that transmitter sideband noise is increasing the noise level at the antenna terminals from  $-125\text{dBm}$  to  $-110\text{dBm}$ . This means that the SNR at the antenna terminals will be degraded by 15dB. If the offending transmitter is lower in frequency than the affected re-

ceiver frequency, a low-pass notch filter should be used at the offending transmitter. If the frequency of the offending transmitter is above that of the affected receiver, use a high-pass notch filter.

In Figure 4 on page 23, the offending transmitter's frequency is below that of the affected receiver. A low-pass notch filter has been placed on the offending transmitter. The sideband energy at the frequency of the affected receiver is "notched" out of the sideband noise spectrum. The notch filter can be placed at the output of the transmitter. However, because most of the sideband noise

originates within the exciter, a notch filter is placed between the exciter and the power amplifier, or intermediate power amplifier. Reducing the sideband noise with the notch filter should improve the S/N ratio at the affected receiver.

## Conclusions

If the ambient site noise at the receiver location were much higher than in the examples, the tower-top preamplifier would be of no benefit. It might do more harm than good. If the receiver system is a base-to-mobile operation, then increasing the antenna gain on each end might help, as long as the ambient site noise is fairly low. Increasing antenna gain at a high site noise location might not yield the expected results.

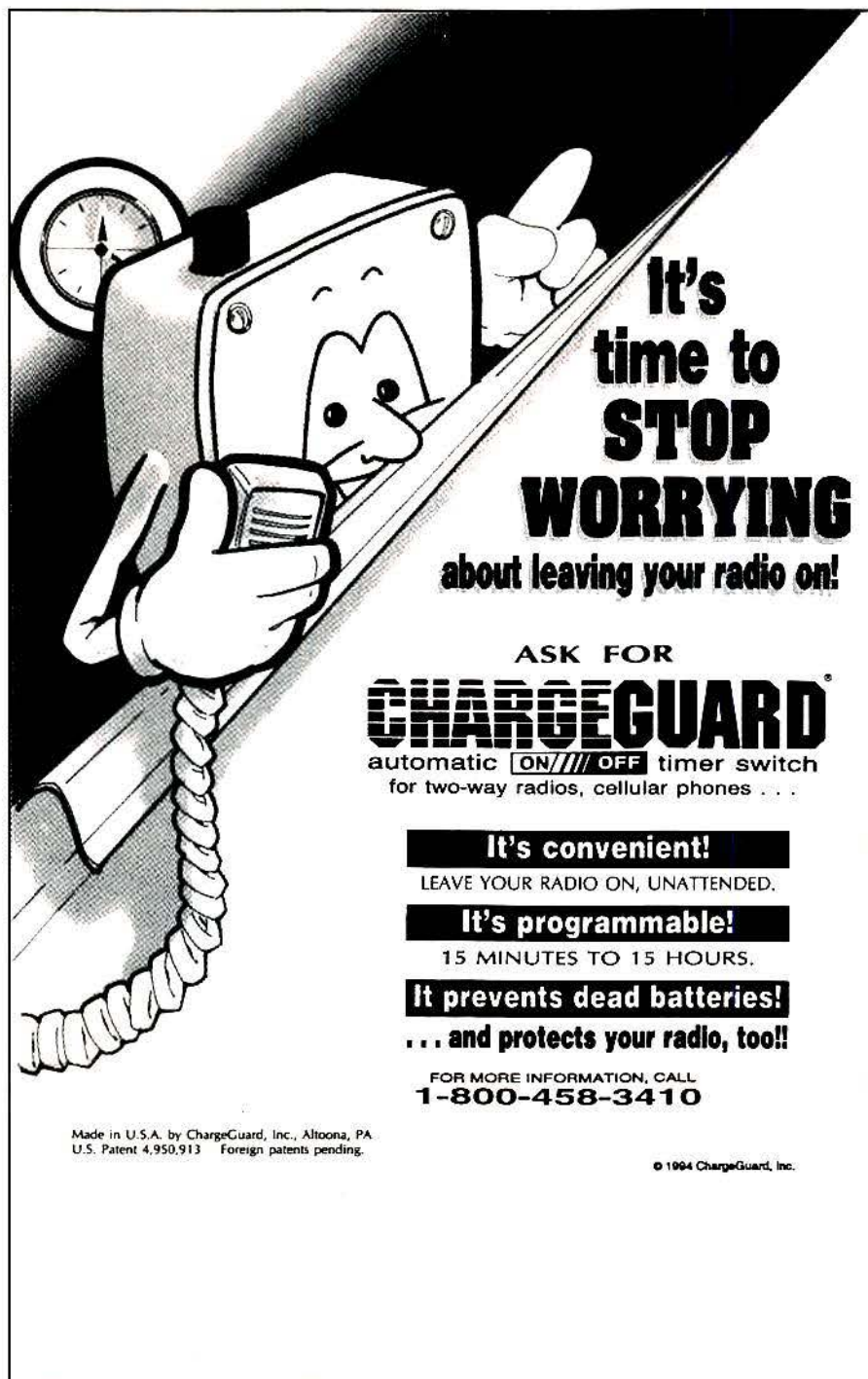
Changing an antenna from a quarter-wave whip located on a fender to a  $5/8$ -wave "gain" antenna located on the vehicle's roof might provide significant improvement in the SNR at the receiver. Using directional antennas can help in point-to-point communications and even in certain base-to-mobile applications, depending on the required coverage pattern and the location of major noise source(s) relative to the direction of desired coverage. For example, if a highly directional antenna is "looking" toward the noise source, the situation might show no improvement when compared to an omnidirectional antenna.

If the transmission line loss is high, then changing to a low-loss line might improve the SNR, but not if the ambient site noise is high. Using a more sensitive receiver might help at sites where the site noise is low, but not in high-noise locations. Changing a receiver sensitivity from  $0.3\mu\text{V}$  to  $0.2\mu\text{V}$  changes the receiver noise floor from  $-117\text{dBm}$  to  $-121\text{dBm}$ , an improvement of 4dB. However, this 4dB improvement might not show up in the final SNR at the receiver input—especially at high-noise locations. Careful planning and calculations should be done before making system changes in an attempt to increase the SNR of the receiver chain.

Until next time—*stay tuned!* ■

## References

- Anderson, David, "GaAs FET Subsystem Advancement Improves Two-way Radio Range," *Mobile Radio Technology*, April 1985.
- Mann, Ernest N., *An Introduction to Radio Frequency Theory*, Mannbros Technologies, 1988.
- Ott, Henry W., *Noise Reduction Techniques in Electronic Systems*, 2nd ed., John Wiley and Sons, 1988.
- Rohde, Ulrich L., Jerry Whitaker and T.T.N. Bucher, *Communications Receivers*, 2nd ed., McGraw-Hill, 1997.



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# EMERGENCY CENTRAL

*A rural Missouri county consolidates its public safety, fire and dispatch operations to contend with creeping urbanization and tourism.*

## Public Safety



By Nikki Chandler

Branson, MO, has earned the nickname of "The Second Nashville," with its country music theaters, restaurants, theme museums and outlet malls. Just a few miles "down the pike" from Branson is Stone County, MO, with a permanent resident population of about 30,000. Stone County has its share of attractions, too, such as the Silver Dollar City theme park and the Ozarks' recreational lakes. Millions of tourists visit the area each year, which increases the potential for boating, auto and tour bus accidents and, consequently, the volume of 9-1-1 calls.

In this area that was historically rural, 9-1-1 services had been non-existent until the recent exponential growth. Stone County had relied on two dispatch centers: one operated by the county sheriff's department and one in Kimberling City's police department. Citizens with emergencies had to call a standard seven-digit number. In 1996, however, Stone County voters approved funding for 9-1-1

service and new public safety computer-aided dispatch (CAD) systems. They followed up in 1998 by approving construction of a new, centralized dispatch center. The center brings 16 public safety agencies under one umbrella, which has been a national trend for smaller to mid-size communities that cannot afford dispatch centers in each individual town or for each agency.

Malcom Vedane, director of Stone County Emergency Services (SCES), said, "We have 16 different tax-funded government independent agencies all agreeing to come under one roof for central communications. We've got new FCC licenses, new repeaters for signal strength scattered around the county and a new tower 'out back.'"

The building and site construction and the equipment installation was finished in February. The center went to 24-hour rotating shifts with simulated calls on March 1, and it went live on March 14. By the beginning of April, the center had already taken 1,800 calls.

**A public safety barnraising**  
Centralization can make enhanced

9-1-1 communications more affordable for small-town America.

"Five years ago, counties of the 30,000 population range couldn't afford the technology it took to do all this. But with the technology explosion and the implosion of prices, it became affordable," Vedane said.

All it takes is approval, planning and organization (which is easy enough to say). Dave Wunderlin, general manager of mobile radio dealer Radio Communications Specialists (RCS), Joplin, MO, a principal vendor for the new center, said that preparing and organizing was important in the centralization of county 9-1-1 services.

"That's the whole key—data gathering and knowing what infrastructure is out there and what user equipment is out there before you even start to design your system," Wunderlin said.

Centralizing several public safety agencies and working with different vendors requires everyone's cooperation. Wunderlin said that all the agencies involved had to be partners. "From the guy I interface my radio with to the console system [supplier], everybody has to be on the same playing field."

Chandler is senior associate editor.





## STONE COUNTY EMERGENCY SERVICE 911 CENTER

With only one 9-1-1-dispatch center in the county, reliability is important, too, and Vedane has made efforts to ensure the trustworthiness of Stone County's center. "It's very, very crucial that if you're going to have centralization, that you have dependability," he said.

Vedane made sure there was redundancy in the telephone lines, electric power and grounding. SCES has telephone cables coming into the building from two central telephone offices. One cable from downtown Branson and one cable from Branson West connect the telcos to the center at two separate building entries. "If the cable gets cut this way, to downtown Branson, I'm still alive from the cable feeding out this way," Vedane said, indicating the redundant entry.

SCES also converts all electric power from ac to dc for reliability purposes. Everything in the center, including lights, works off dc power.

"I have no spikes, no dips, no interruption," Vedane said. The center has its own generators and backup universal power supply, with enough redundancy

to remain in operation for two hours, even if the generator fails.

The Ozark mountains breed thunderstorms, so lightning is always a threat at this highest site in the county. Because SCES sits 1,400 above sea level, with the top of the tower reaching 160 feet above ground level, the center's designers implemented a thorough grounding scheme. The grounding system provides less than 5Ω resistance to ground. Internally, it has zero ground potential difference. The center has a complete halo ring, with every piece of equipment, every length of fence and every antenna grounded. Lightning transients would have to pass through three filters before reaching the universal power supply. Every cable is busbarred—inside at the grounding field, outside at the tower and again at every antenna. The last defense against any surge is a thick grounding cable that is buried three feet deep and backfilled with black soil. Humidity from inside the SCES building is pumped into the fill soil, which keeps it moist to decrease resistivity. The pressure points are all cadwelded, so no loose connection exists anywhere.

"The groundwheel is the most critical part of the communications center," Vedane said. "Dealing with the dollars we have invested in this equipment, it would just be foolish not to have the best ground field." Vedane said the \$4,000 to \$5,000 price tag to construct the grounding field was minor compared to other project costs and to the damage it would prevent.

### Decisions, decisions, decisions

The total cost to construct the center, and to install all the equipment and services, was \$1,200,000, and nothing was left to be desired. Since the SCES board was first appointed in 1997, Vedane and other members have worked diligently on the center's planning and construction. They attended trade shows, such as the Association of Public Safety Communications Officials—International (APCO) Conference and the Missouri National Emergency Number Association (NENA) Conference, and read "volumes of trade magazines." They also visited other centers that were under construction or were upgrading.

In its search for vendors, which





The Voice Pro logging recorder aids in training and accountability in the 9-1-1 center.

Vedane calls "technical partners," the board took a minimum of three bids on

each subsystem, such as the CAD system, voice recording and logging, and the radio system itself. In some cases, the board took five bidders. Vedane considered customer satisfaction, installation practices, pricing, and follow-up service and upgrades to be key points for reviewing proposals.

"Our theory was to start off as close to the leading edge as we could, without taking technical risks ... and then direct the budget so we could stay there," Vedane said. With the CAD system that Vedane chose, Stone County will have

four new versions a year. Global Dispatch Technology, Oklahoma City, provided the CAD system, CAD Assist 2.4, which is supported by quarterly updates. [See "Computer-aided Dispatch Comes to the Ozarks," *MRT*, August 1999] Glo-

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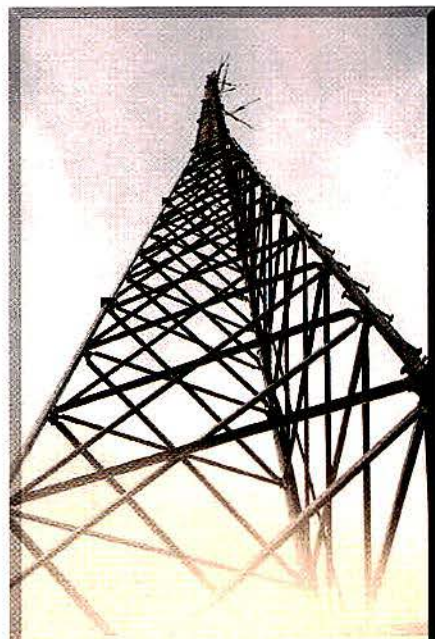
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- 3 110W high-power VHF Tait repeaters (with TX RX Systems duplexers)
- 2 multichannel Kenwood backup radios

All antenna system components

## Other facts about Stone County radio communications

Radio system: conventional, VHF highband

Radios used in field: Includes Kenwood TK-270, 250, 730, 790, 280 and 290 series.

Number of dispatch positions: 4

Number of agencies coordinated: 16

Total cost of center: \$1.2 million

Height of tower: 160 feet



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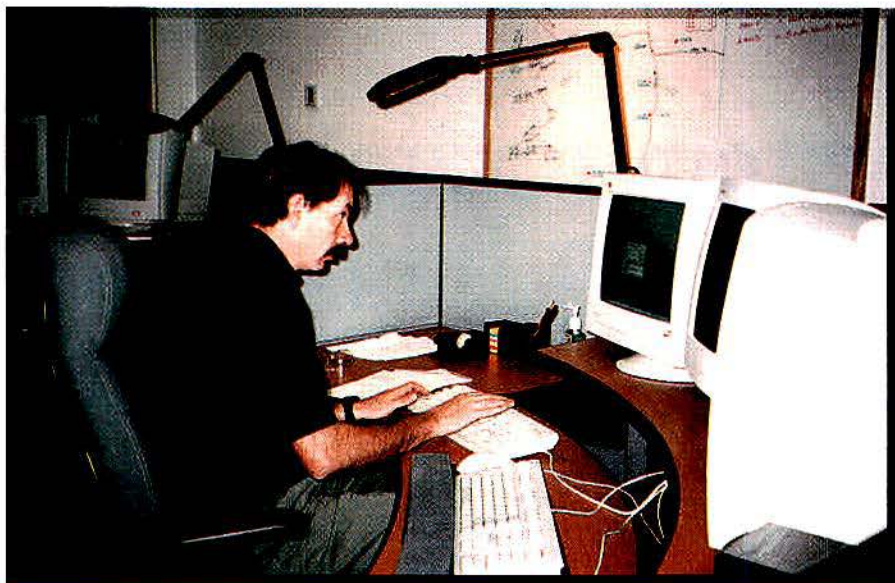


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All of the furniture in the dispatch center easily adjusts to the dispatcher's height. Marty Allen, manager of training, logs on to CAD Assist, the center's CAD software.

bal Dispatch specializes in systems for centers serving small and mid-size communities that need dispatching and mapping. CAD Assist is customer-configurable and features integrated advanced mapping and geographical districting technology.

Baker Integrated Technologies, Atlanta, provided the center's telephone and radio interface, Dispatchworks. This

system uses a sophisticated graphical user interface (GUI) to integrate advance call-taking and dispatch features including radio, telephone, E9-1-1, TDD and instant recall recording. Its modular design allows system expansion through the addition of hardware. It can be configured through software settings with all console equipment being physically identical, so meeting future demands

can be done with simple migration.

The enactment of more rigorous E9-1-1 requirements means automatic number identification and automatic location identification, mapping and addresses have to be accurate—and those addresses all had to be entered. That mandate posed a challenge to the SCES team. Most of the county roads were only known by numbers, and many street names and addresses were similar. So, the department had to put the county through an address conversion.

The department solicited the aid of the Stone County Historical Society to help preserve the area's "naming" history, and then it formed a road-naming committee of local citizens and government officials. The cities within the county cooperated also, and although the county did not have jurisdiction over city addressing, the mayors could deflect any complaints by citing county 9-1-1 requirements. Some citizens did object to their new road names, but the department did not budge because of the importance of dispatch accuracy.

Recording and logging calls is crucial to 9-1-1 for both training and accountability purposes. Vedane chose the Voice Pro recorder by Racal Recorders.

"Voice Pro is probably considered the

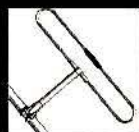
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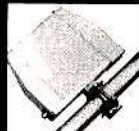
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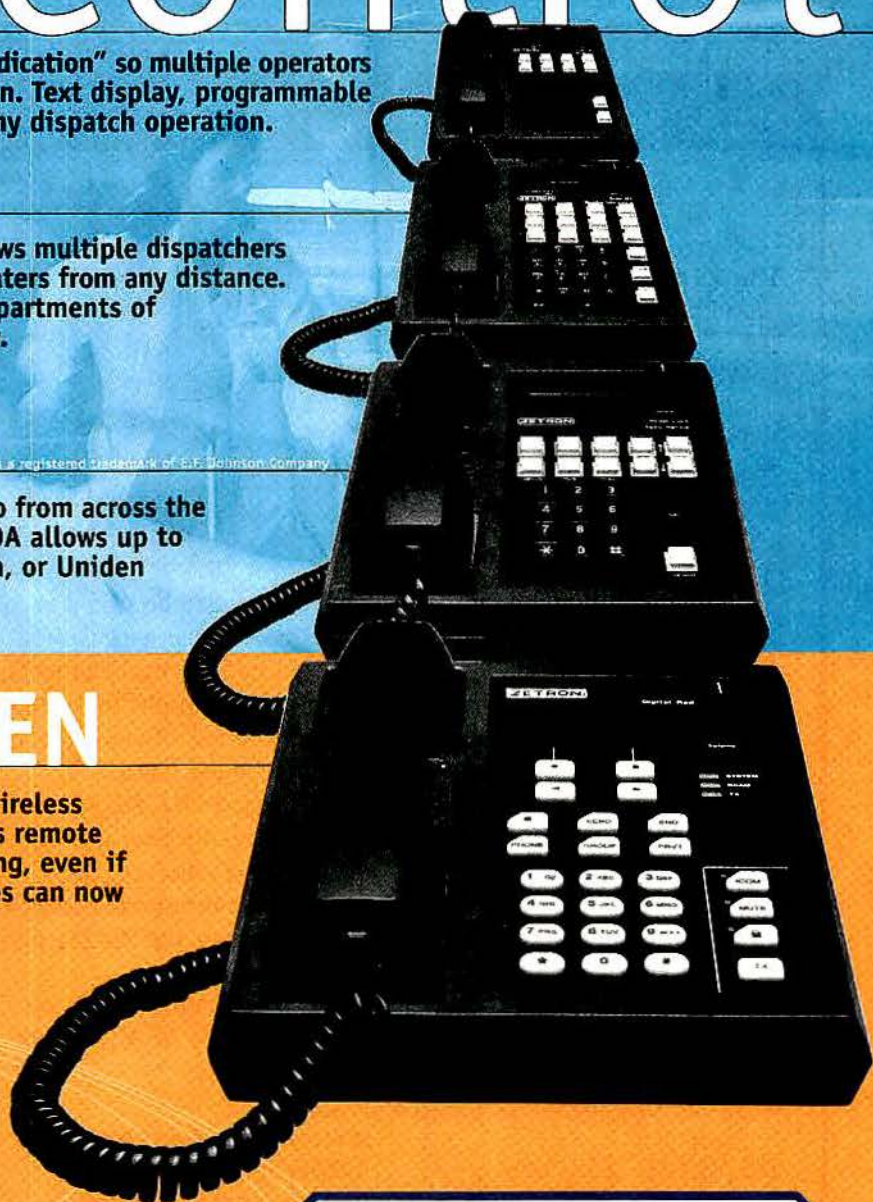
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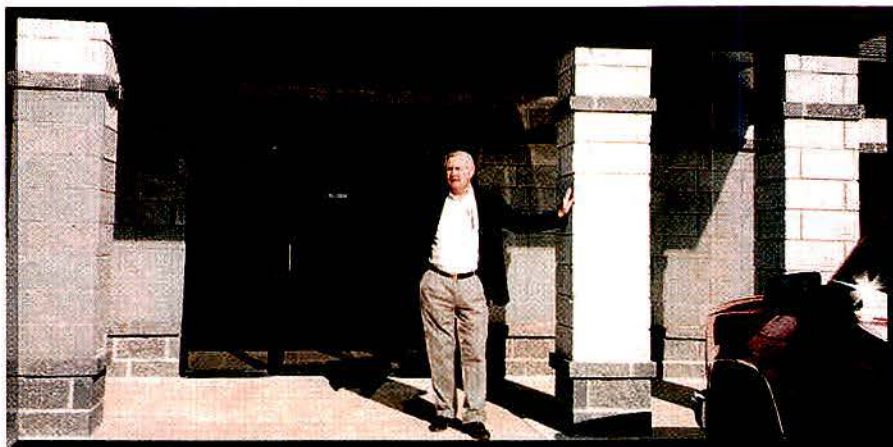
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SCES hosts an open house Feb. 22-25, allowing citizens to tour the center before it goes live. Malcom Vedane, SCES director, receives visitors at the entry to the building.

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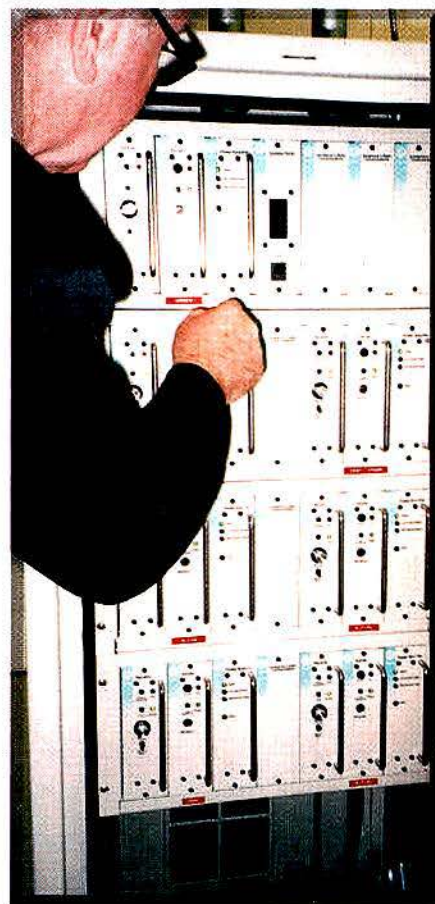
Cadillac of recorders. There are several things we didn't 'go cheap' on. One is the recorder," Vedane said.

Another integral part of the center that received generous funding was the furniture. The call station tables are powered so that they can be raised and lowered independently from the monitors. The chairs, provided by Domore, are "outstanding for comfort and durability," said Vedane, which is important when they are going to be used 24 hours a day.

RCS provided all the radio equipment and repeaters.


"We did a lot of work with [Stone County] upfront," Wunderlin said. "In the entire process, we've been an integral part, from the conception of their 9-1-1 services, and we were a major provider of services for a lot of user groups, which are going to be internal customers to the Stone County 9-1-1." Wunderlin said that SCES is a full, well-rounded service center. (See "Radio Communications" on page 28.) RCS used Tait control stations, base stations and repeaters. The company contracted out the tower construction to Southwest Communications in Springfield, MO.

"All of the products are modular components. If a power supply fails, you can



The radio relay cabinet containing Tait receivers, exciters and power amps sits in a large control room.





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swap out a power supply. They are also rated for continuous duty. All of the off-site repeater sites are battery backed-up," Wunderlin said.

**Special touches for special people**

The motto for SCES is "Committed to Excellence," a goal that was evident in the special touches Vedane added when he planned the center and when he set the policies. Admittance to the dispatch room is restricted to on-duty dispatchers and supervisors.

"We want to set a tone of professionalism, which includes no visiting, no noise levels, no people laughing in the background while we're dealing with somebody whose baby is choking," Vedane said. "It gives employees a sense that they are not 'going to work' but 'reporting to duty,' and we emphasize that over and over again."

Many accommodations in the center are geared toward benefiting the people on duty. It has a full kitchen, lockers in the restrooms, a shower and a half bath to save trips to the main restroom. The center has two large windows on either side of the operations room, one in the kitchen directly behind the main operations room, and one in the supervisor's room in front. Employees can easily see outside at any time.

The hot-water tap even has a circulator pump on it so that employees do not have to wait for the hot water to flow from the water heater.

"It's a little more expensive," Vedane said, "but it does encourage people to wash their hands. They don't have to sit there waiting for hot water to show up. We're constantly thinking about how we can help the emergency communications specialist. We want to reinforce how important they are, to reduce stress."

The air is even filtered differently in various parts of the building. The air circulates twice as fast in the kitchen and supervisor room, on either side of dispatch, for fresher air to prevent illness.

Although the operations area is off-limits to visitors, a large glass panel separating the conference room and dispatch room can accommodate scout groups, fire groups and board of director meetings that wish to observe operations.

"We didn't want to freeze the people out because it [the center] really is the people's," Vedane said. "We built it that way, and they can't see anything that is confidential from that perspective."

The center's grounds even have an area to set out lawn chairs and picnic tables. Barbeques are being planned so that 9-1-1 dispatchers can mix socially with the sheriff's deputies, firefighters and ambulance teams.

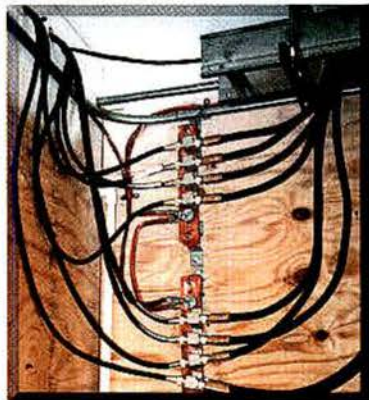
**Room for expansion**

Stone County was ranked as the 31st fastest-growing county in the United States last year. Branson development is expanding west into the county, which boasts big lakes, rolling hills and mountain bluffs. With such rapid growth, the

emergency services department has allowed room for expansion as well. Currently, the center has four main dispatch positions. By 2007, SCES plans to add two additional dispatch positions by relocating the wall that separates the conference room from the operations room.

When Stone County built this centralized dispatch center, the emergency services department not only took the growth of the county into consideration, it also chose vendors that would update equipment and provide technical support so that the center would not slip back in technology or size. The center was built on one acre in Branson West, donated by Stonebridge Village, which is a private

residential community. That one acre was all that Stone County needed to locate its building, tower, parking lot and picnic area. The scenic lot even includes bit of wildlife. A curious red fox was one of the first visitors to the new center earlier this year.



The grounding field provides less than 5Ω resistance to ground.



Gary Crossen, manager of technical support, inputs the CAD software into the main server.



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# It is heaven—and it is Iowa

*From startup company to multistate digital network, Racom has grown its business by making outsourcing of communications attractive to public safety and commercial users alike. For Racom owner Gregg Miller, Iowa has become a 'Field of [Wireless] Dreams.'*



By Thomas G. Dolan

What do you do if you are a "little operator" or, for that matter, even a "medium-sized operator" in an industry in which mega-giants are consolidating everything in sight? One strategy is to await the inevitable and hope you get acquired at a price that will enable your early retirement. Another approach is to search out a niche that will sustain *your* operation, but is too small for national or international competitors to put forth effort. An alternative approach that is difficult—and rare—is to find a *new* way to compete in the same league with the big operators.

The latter approach describes Marshalltown, IA-based Racom Corporation. Racom currently operates one of the largest digital wireless networks in the upper Midwest. The typical approach has been for the provider to sell the entire infrastructure—towers, antennas, equipment and buildings—to the customers. The idea that Racom's president, Gregg Miller, embraced was to retain ownership of the infrastructure, expand it as necessary and simply lease air time to customers. Users in small rural areas, such as regional manufacturing operations and, especially, public safety officials, gain access to state-of-the-art communications systems that they otherwise could not afford.

Miller recalled nostalgically the early days of the two-way industry when radio hobbyists began their "mom and pop" garage-based operations. Miller, who started with amateur radio too, was part of that process. He and his wife, Sally, started Racom in 1972 in the attic of their farmhouse. (Racom was selected for the company name as a contraction

Dolan is a freelance communications writer. Additional information for this article was contributed by the *MRT* staff. More information about the company is available online at [www.racom.net](http://www.racom.net).



# Private wireless turns to Racom

Racom's private wireless customers include hospitals, resorts, energy companies (like Utilicorp), petroleum distributors and well-known international manufacturers (like Deere & Company, Rockwell International and General Mills). Although many such companies own and maintain their own radio systems, Racom's clients often have specific reasons for outsourcing.

"Part of the reason for that was many of them have some wide-area component to their operations," said Racom President Gregg Miller. "General Mills has plants in Cedar Rapids and in Iowa City, for example, so they have a lot of people in crews and work teams that are shared amongst them. Having communications not only *within* their facilities, but *between* their facilities, was important.

"Deere & Company has plants all over [Iowa]," Miller said. "Their corporate security is centralized in corporate headquarters in Moline, IL, but from there they actually run CCTV cameras on leased circuits all the way back from Waterloo, Ottumwa and Des Moines. So, being able to dispatch security and functions like that from a centralized location, remotely, to a wide geographical area lent itself very well to a wide-area SMR system."

"In many large organizations, their budgets are compartmentalized," Miller said. "Maintenance has a budget for radios, security has a budget for radios, and IT has a budget for radios. Getting them all to sit down together is nearly impossible. Yet, there are needs for all of them to communicate on one system from time to time.

"The features of a trunking system—multiple talk groups, interconnection with the telephone network, individual calls, simultaneous conversations—all of those kinds of things that a multichannel trunked system can buy you—are good features to

have, but that much radio may be too expensive for a single department to budget for. So, one department starts out with it, and we gamble on the fact that once it's in there, there'll be more folks that will join it. Before you know it, two or three years later, there are 300 radios operating on the system."

Miller estimated that Rockwell uses about 250 to 300 radios just at its Cedar Rapids complex.

"We take the business risk," Miller said, "that if we can get in and establish a network site for one of the departments, and the potential is there for many others, then our sales people will have to make sure that they make everybody else there available."

## Marketing to business wireless users

Business user marketing is not too different from selling to one police department in a county, Miller said. The anchor client alone doesn't pay for the cost of the network build-out. It is the same business model for an industrial, medical or educational complex as for a county, he said.

Miller referred to a salesman's report from northwest, suggesting that the company add a site in west-central Minnesota. A market survey rated prospects from "no interest" to "Where do I sign up today?" Prospects for the new system included crop consultants, area transit and schoolbus services, co-ops, energy and fuel companies, sheriffs, plumbers and contractors. One multistate painting contractor interviewed said he had 50 cellphones, but 70% to 80% of his calls were internal. He was "very interested" in mobile radio as an alternative.

"That's the kind of marketing survey we do," Miller said. "We go in and contact as many people as possible. So now, it's sort of up to us to say, 'Well, is there enough interest here, over the next one to five years, to spend \$150,000 to \$200,000 a site?' It's just a logical, commonsense approach to it."

## Wireless @ Work



Deere & Company uses communications to link multiple sites all over Iowa.

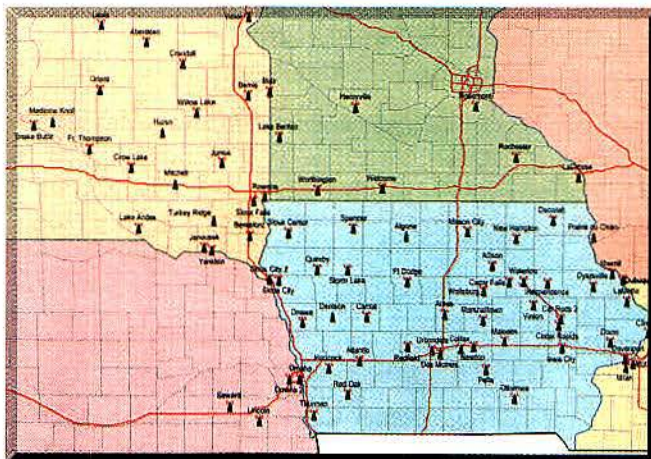


Rockwell International uses hundreds of radios to coordinate in-plant activities.

of the words "radio" and "communications.") Sally ran the office, while Gregg spent his days on the road selling radios and his evenings processing orders.

Along the way, Miller designed a number of innovative communications systems, including a mobile system using a satellite for uplink and downlink. He designed and constructed a network of 800MHz radiotelephone systems. In 1993, Miller acquired enhanced specialized mobile radio (ESMR) licensing and began construction of a network that would eventually cover seven states.

The company's resources include



Racom Corporation has 14 branch offices and 8,000 customers in Iowa, Minnesota, Nebraska, South Dakota, Wisconsin and Illinois. It is still building out its EDACS network, with seven more sites being planned.

Opposite page: The Racom headquarters in Marshalltown, IA, offers high security to meet requirements of the company's public safety and utility customers.





Racom President Gregg Miller, pictured with an amateur radio station in his Marshalltown, IA, office, started the company in a farmhouse in 1972.

4,000 contiguous 800MHz channels with which it serves more than 8,000 customers. Racom's channels lie in the 861MHz-865MHz band and, theoretically, are subject to relocation by 800MHz auction winners, primarily Nextel Communications. Miller isn't worried, however. The digital network is only using about 500 to

600 of the 800MHz channels, so the remaining spectrum may be sold or traded. As a member of the board of directors of PCIA's Mobile Wireless Communications Alliance (MWCA), Miller has worked for an "SMR incumbent bill of rights" and relocation to comparable spectrum for 800MHz incumbents.

"As it is, we feel absolutely comfortable in telling our public safety customers that while we may have to go to new frequencies in the 800 band, it'll have to be done in such a way so that it's totally transparent and seamless to the end users. The only way to do that with a network of our size, we've concluded, is to put up a parallel network. So it may be that Nextel will just leave us alone. They don't have that many of us [operators] that are of this scope and size to contend with, and so they may just decide that they're going to have to build around us and leave us alone," Miller said.

In addition to public safety agencies, Racom's government clients include highway departments, public works departments, prisons, water districts and the U.S. Corps of Engineers. The corporation has numerous large and small private clients as well. (See sidebar on page 37.)

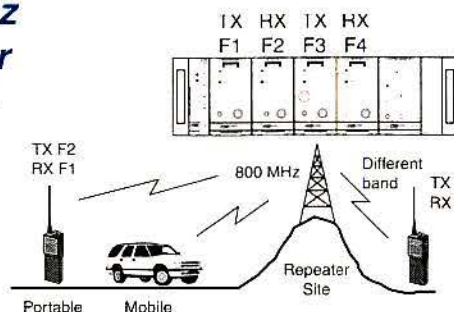
#### 'The loser now will be later to win'

Miller admits the idea of leasing network space, as opposed to selling infrastructure, came about by accident. In 1994, officials in Polk County, IA, decided they needed a new 800MHz system for the county's public service agencies. They went about it the usual way, getting officials and users together,

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hiring a consulting engineer, writing a spec and drafting an RFP. Racom bid the job at \$8.4 million, but Motorola underbid Racom with a price of \$6.7 million.

The county's radio committee spent about six months evaluating the bids and visiting the two companies. It recommended to the county board of supervisors, which held the pursestrings, that the county accept the Racom bid, even though it was \$1.7 million higher than Motorola's. There were several reasons, Miller said, including what the committee felt were superior features, such as the Racom's use of Ericsson's Enhanced Digital Access Communications Systems (EDACS).

The board accepted the committee's recommendation by a 4-1 vote, with one qualification—the acceptance was contingent on the passage of a bond issue the following November. Motorola persisted in pursuing the contract with a campaign against the bond issue. As a result, a strange situation developed. An out-of-state company was encouraging Iowa voters not to pay what it considered to be an exorbitant sum asked for by Racom, while local officials were going door to door asking Iowans to underwrite that sum.

The referendum failed. Motorola

won—at least in the sense that Racom did not get the job—but Motorola did not get the contract either. Polk County also lost. It had nothing to replace its antiquated communications system.

A way out of the impasse came when a sheriff asked Miller, "Don't you guys have an 800MHz license? We could come up with maybe \$1 million. Couldn't we plug into your system to solve our immediate problems, then pay you a monthly access fee until we find a way to get the rest of the money?"

"It sounded pretty good to us," Miller said. "So that's how we got into the business. The more we got into it, the more interesting it looked as a business direction in itself."

#### From accident to business strategy

An accidental situation generated the idea, but it was no accident the way Miller picked up the idea and ran with it. In about 1995, Blackhawk County, IA, was going through a similar process. Outside bidders set a system price of \$7 million, but Racom bid \$3 million, plus annual maintenance costs. Racom also offered access to a network that would soon spread throughout the state into neighboring states.

The system soon received a serious

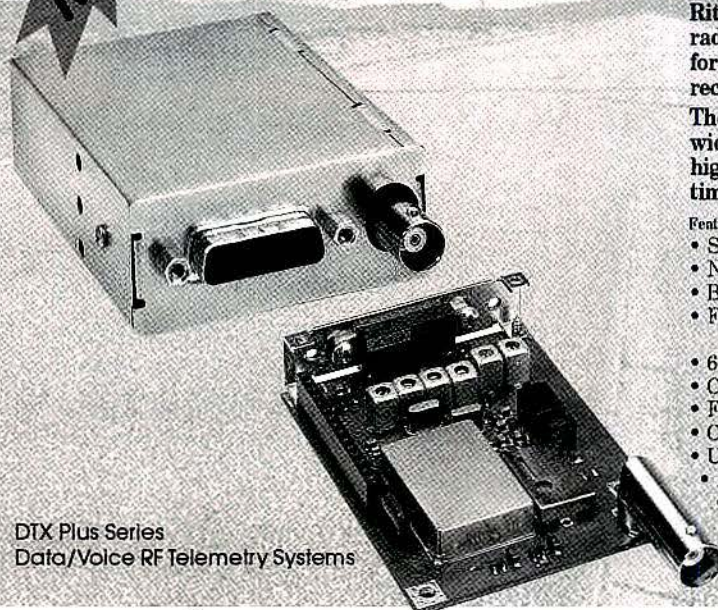
trial and validation in Blackhawk County when the area was ravaged by a series of severe floods. One small town, Dunkerton, was almost completely inundated. The utility companies had to go out in boats to disconnect gas and electricity. Racom's system enabled integrated communications among law enforcement, utility companies, rescue teams, hospitals and other entities.

"Usually, if there's a fire, one of the first things the firefighters have to do when they arrive on the scene is call their dispatcher to call the utility companies and tell them to turn off their power," Miller said. "But now, they can make that call over the same network." The channels are integrated, but are also prioritized, with law enforcement having top priority.

#### Continued growth

Racom recently completed a project for the picturesque Dubuque County, setting for the movie "Field of Dreams." Outside bidders offered to create a radio system for \$9 million, but Racom came in with a bid of \$3 million, with \$250,000 a year for ongoing expenses. So much for the "economies of scale" that allow large companies to underbid smaller ones. Although Miller had been

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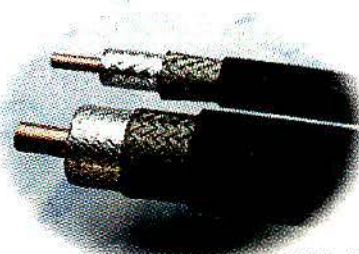
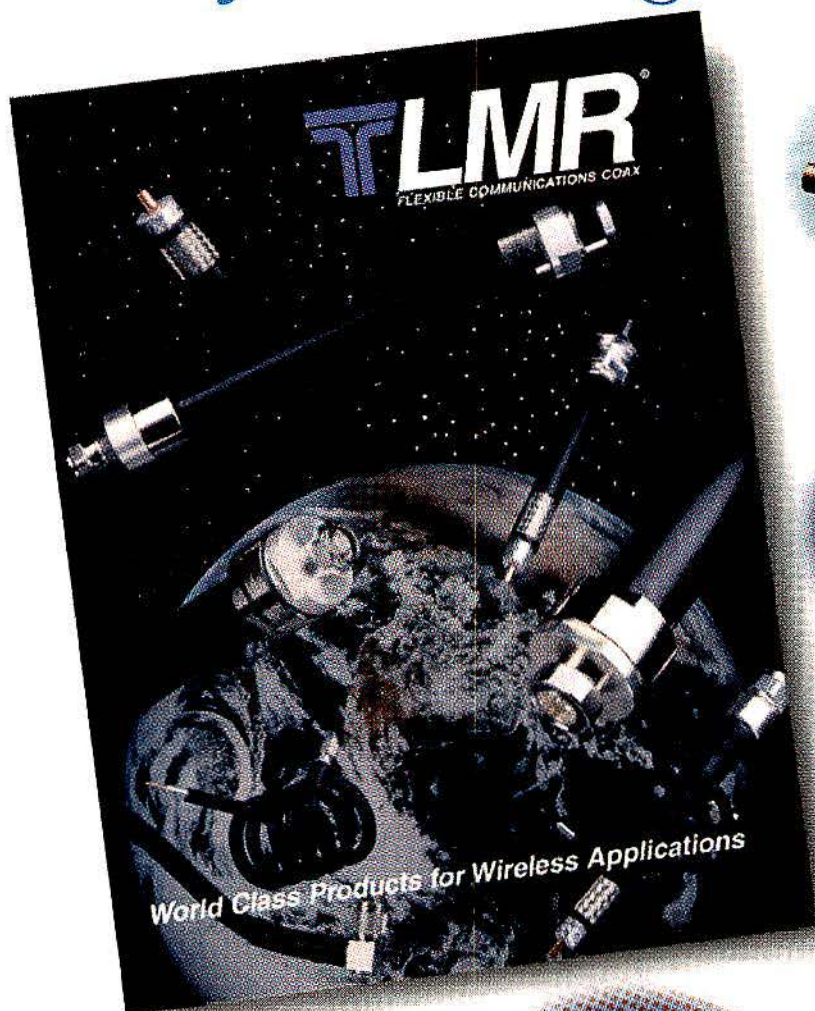
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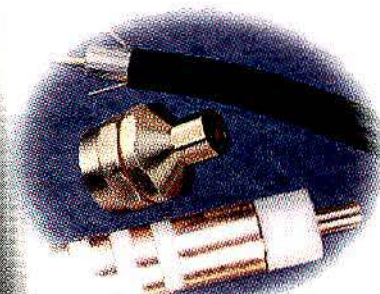
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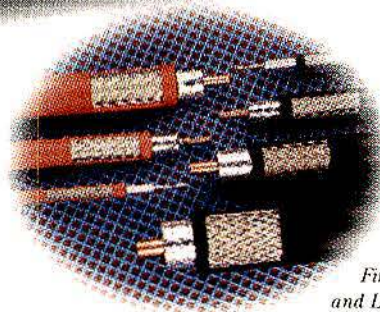
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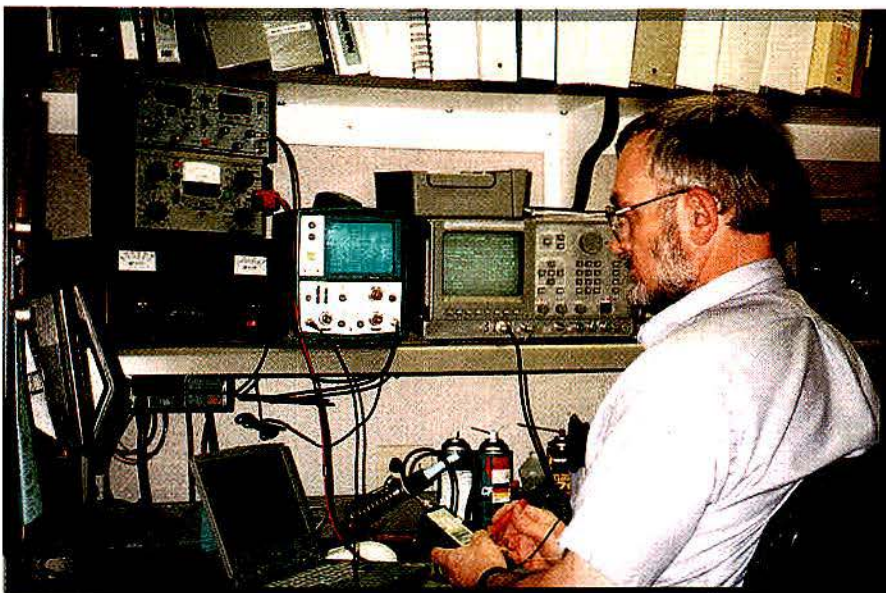
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Racom Service Manager Glen Christen records test measurements with a laptop computer.

a bit piqued at Motorola over that first encounter back in Polk County, now he says "I could go back and give Motorola a big kiss."

Racom now has 14 branch offices and more than 8,000 customers in Iowa, Minnesota, Nebraska, South Dakota, Wisconsin and Illinois. Racom continues to build out its digital network, which represents an investment

of about \$50 million.

"Our extensive infrastructure of towers, facilities and T1 networks, as well as a highly skilled workforce, creates a dual network synergy that is unique in the industry," Miller said. "The two-way radio business is undergoing significant change, both in the types of technology offered and the method of purchasing radio systems, which will create

tremendous opportunities for the limited number of companies with capital and/or frequency spectrum."

Miller said that the industry's migration from older analog equipment to newer digital technologies means more efficient use of spectrum and the capability to handle voice and data simultaneously. Currently, Racom handles about 20 million connections a month, about three million of which are data transmissions. Miller predicted that within a few years this proportion will be reversed, with about 17 million being data calls.

Capabilities of the network are constantly being enhanced, such as a cooperative effort that began in 1998 with Fargo, ND-based IDA to create a GPS/AVL fleet management system compatible with EDACS technology. That first project, for Sioux Valley Southwestern Electric, in Coleman, SD, has been expanded to other places, like Blackhawk County.

"That's a real deal now," said Miller citing applications for ambulances and other public safety uses. "As GPS continues to come down in price, and we figure out how better to integrate all that, I think that's going to become a standard, built-in feature."

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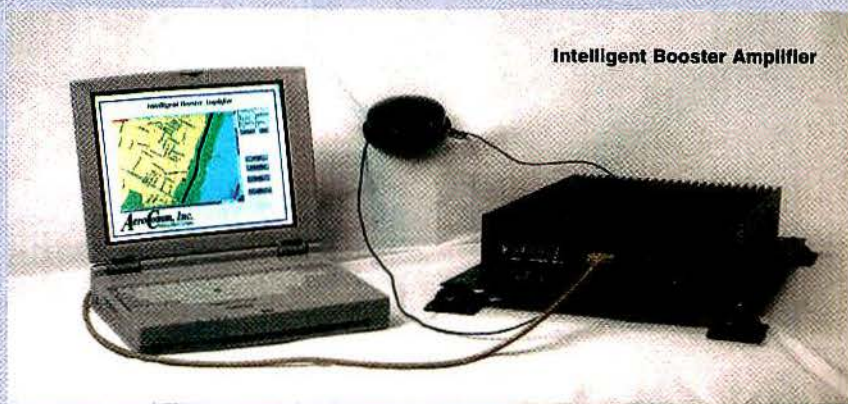


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A Wireless Systems Company

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### Providing wireless content

Other wireless applications are also likely to be offered by the corporation in the future. Miller foresees providing CAD systems, 9-1-1 phone systems and mapping systems, with Racom becoming more of a systems integrator.

"I've got a whole floor of this building that I'm trying to hold open for what I call my 'content' floor," Miller said. "We're sort of a 'pipe' provider now, but I think the future holds a mix of providing not only the pipe, but what flows through the pipe." ESMRs can become data warehouses for mission-critical

customers, he said. He gave as an example becoming a depository for pawnshop records, so police departments can cross-check surrounding towns to track stolen property. Wireless 9-1-1 and map-centric applications are expensive for individual comm centers, but affordable when centralized, he said. "There are a lot of opportunities for content and massaging content, putting it together in unique and needed ways."

### Corporate changes

Racom has gone through a number of corporate changes over the years. When

Miller got the idea to build out an 800MHz system, he capitalized the plan by selling one-third of the company to General Electric. G.E. later combined with L. M. Ericsson to become Ericsson G.E. This business relationship, which resulted in Racom being the exclusive distributor of EDACS technology in the states of Iowa, Minnesota, Nebraska, North Dakota and South Dakota, has been responsible for much of the corporation's growth.

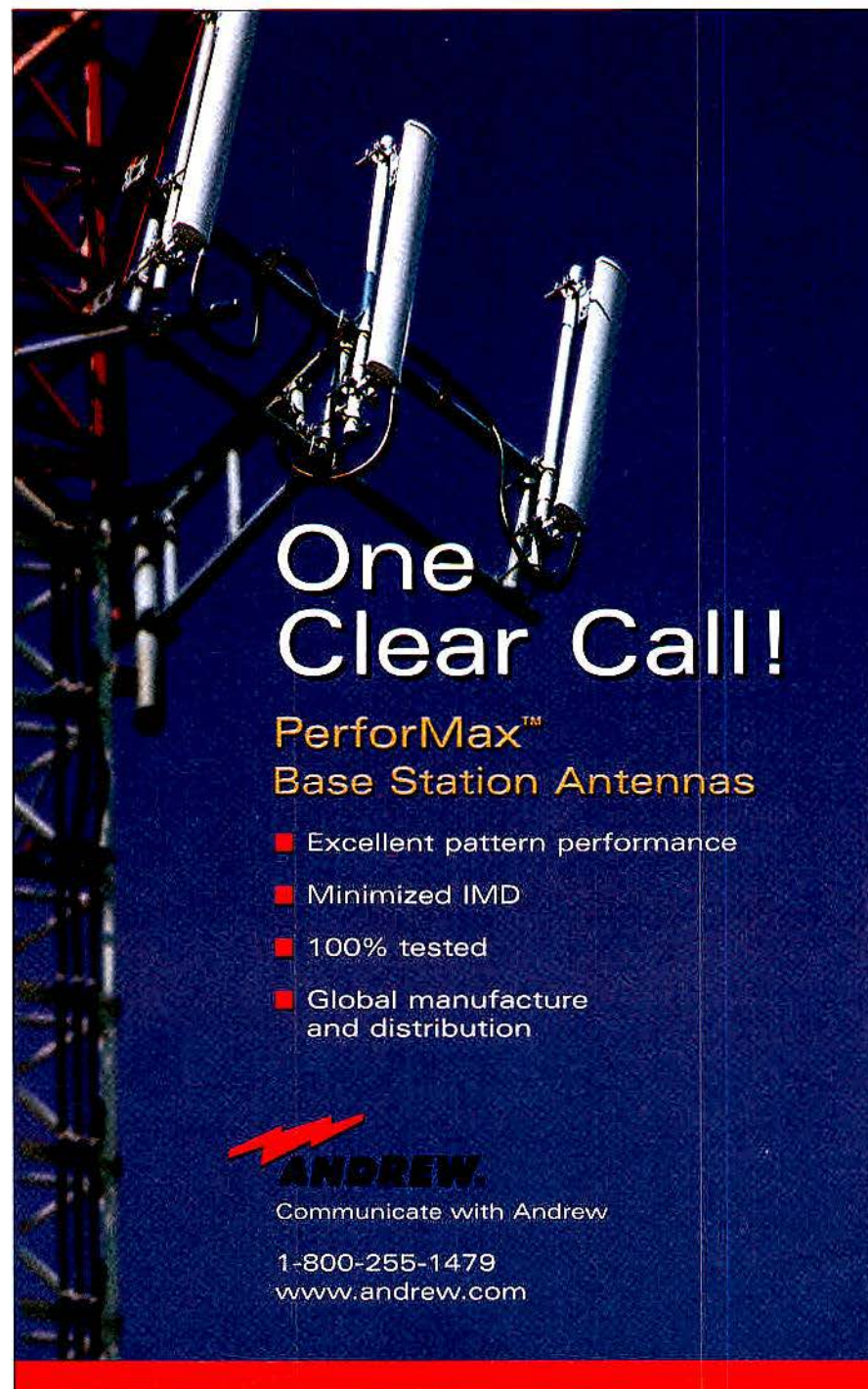
Racom still uses EDACS systems, even though Ericsson is no longer a part-owner of Racom. (Ericsson's Private Radio Systems Division has itself recently been acquired by Com-Net, and the new entity is known as Com-Net Ericsson Critical Radio Systems.) Currently, American Energy Holdings, an \$11 billion diversified utility company with worldwide operations, owns 31% of Racom. American Energy, in turn, was recently bought out by Warren Buffet's group, Berkshire Hathaway, and taken private. Miller joked that Buffet obviously wanted to get his hands on Racom's management team. That team owns 69%, with Miller as the majority shareholder. His son, Michael Miller, now vice president of corporate development, joined the company in 1996 after five years with General Electric.

There is also no enmity between Racom and Motorola. Miller hopes to expand the business to include systems that use infrastructure and equipment produced by the former rival. "We'd very much like to; I think the whole industry is ripe for that kind of consolidation," Miller said. "I think our industry has matured to the point so that only makes sense, so that we who are the local sales and service organizations ought not be tied to one manufacturer but to 'What does the customer really need?' and 'How is his problem solved in the best way?'"

### If you build it, they will come

Miller's foresight in acquiring 800MHz spectrum, the strategic partnerships he forged with suppliers and customers, and his innovative move in leasing network space gives him a competitive advantage. He estimated that Racom is about 24 months ahead of its nearest competitor in building a wide-area, shared, digital voice and data, radio-dispatch and telephone-interconnect communications system.

Which is another way of saying that Gregg Miller no longer works out of his farmhouse attic. ■



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**CS-900** Control Station Interconnect. Has Digital voice delay, Speed-dialer and more. Export version available. Low cost.

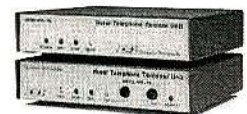
**CS-800** Duplex interconnect with built-in repeater maker. Speed dialer and more. Low cost.

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# CHALLENGES FOR RAILROAD RADIO

*Railroad communications specialists are tasked with implementing data, interoperability and control technologies to improve safety and service. At the same time, they have to conform with revised FRA communications rules and implement a new band plan to cooperate with FCC refarming.*



Communications Infrastructure for railroads includes equipping yard towers as well as dispatch centers, locomotives and maintenance crews.

By D. A. Keckler

For most business and industrial radio users, simple conformity to the FCC's operating and licensing rules is the closest their wireless traffic comes to government oversight. If you stay on frequency, inside your contour and under your power cap, then *how* you use your radio is your business.

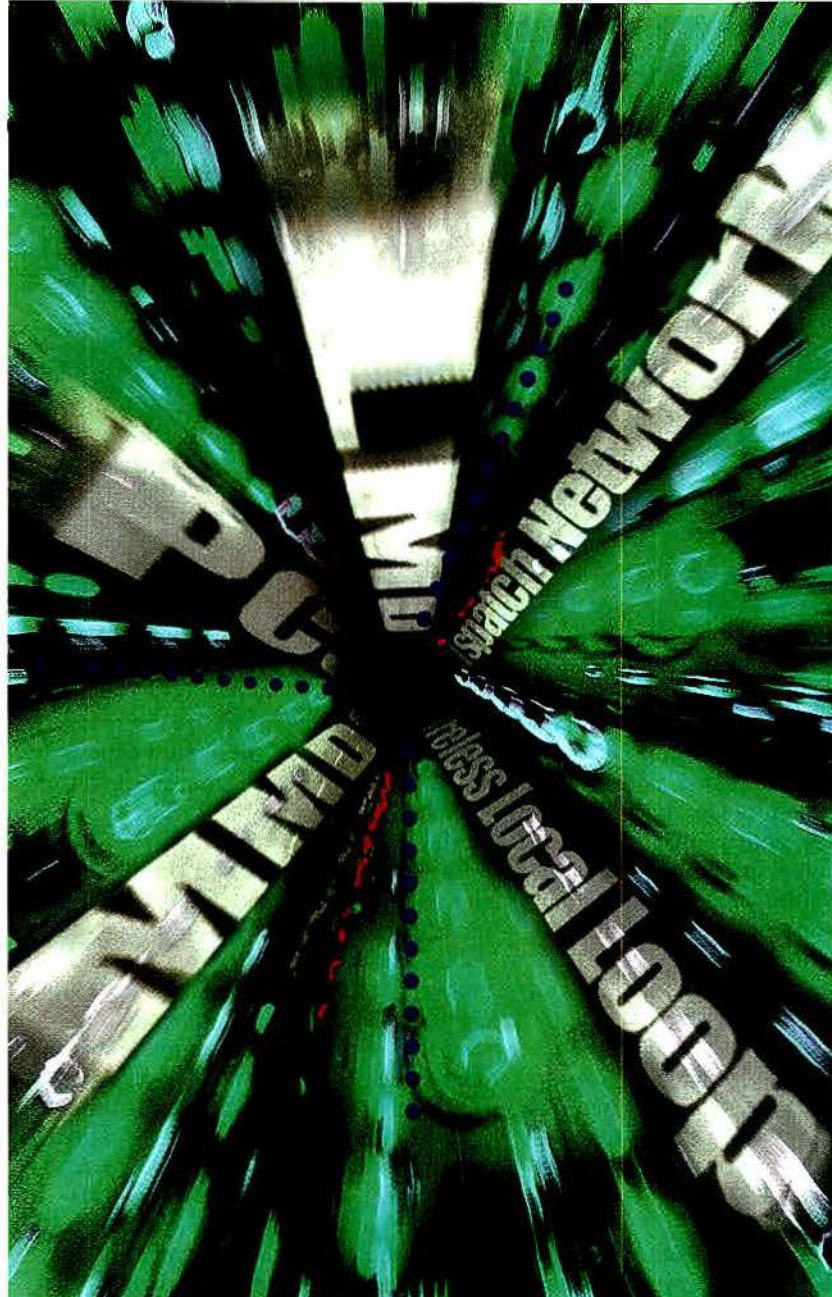
Radio communications for transportation, particularly railroads, is more heavily regulated. Railroads face the same technology issues and spectrum-efficiency problems as the rest of wireless users, but their problems are more complex. Although railroads are ostensibly private companies, their activities in providing public transportation for goods and passengers make them subject to detailed industry stan-

dards and closer federal scrutiny.

A PMRS licensee, such as a manufacturer, is told by the FCC (or the frequency coordinator): "Thou *shalt not* exceed certain limits in your coverage. (And if you have dead areas, that's your *problem*.)" A railroad is told by the Federal Railroad Administration (FRA):

Keckler is features editor.





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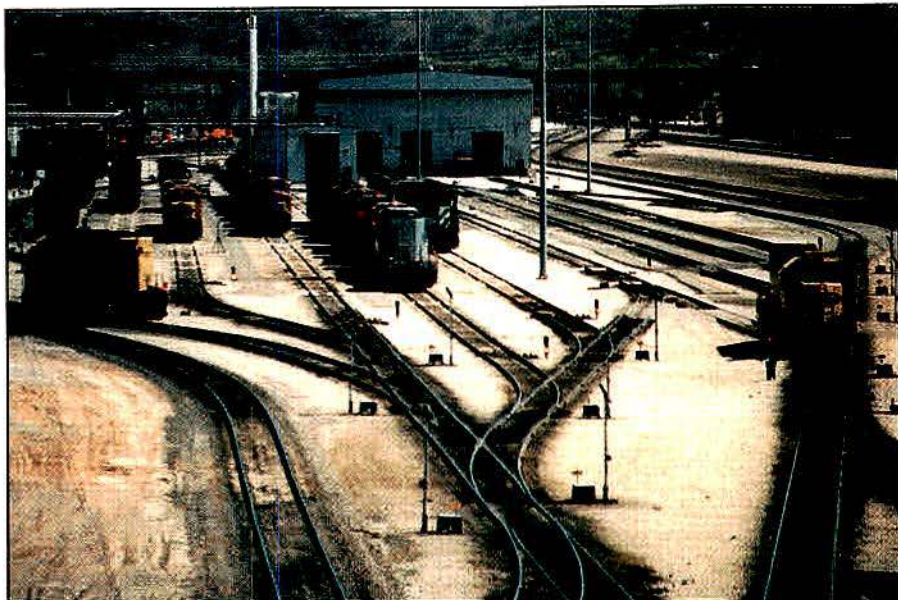
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Rail yards require radio communications not only for train movement, but also for management of maintenance and repair crews.

"Thou *shalt* cover everything you've got. (And if you have dead areas, you're *going* to have a problem, to the tune of \$11,000 a day, until you fix it.)"

Manufacturers and radio dealers that wish to serve this market should familiarize themselves with the challenges the train community faces. Railroad communications specialists are looking for avenues to implement data, interoperability and control technologies. They have to provide conformity to the revised FRA 49 C.F.R. Part 220 rules. And, they have to implement a new band plan to conform with FCC reforming efforts.

### Mixed radio environments

Although railroad voice and data communications take place mostly at 160MHz, other frequencies are involved in a growing world of monitoring, alarm and rail safety equipment. In some cases, this brings the FCC to new applications of its delegated authority. Last year, the FRA mandated the installation of "advanced civil speed enforcement systems" (ACSES) in the northeastern U.S. railway corridor. The equipment, first used in Europe, consists of a transceiver and antenna located under the locomotive. It polls transponders spaced along the track bed for safe speed information. Because the equipment operates at 27MHz (used by citizen's band radio) for polling, and the transponders' data bursts are at 4.5MHz (civil air patrol use), the railways had to request interim authorization and a rules waiver from the FCC to comply with FRA mandates.

Other railroad initiatives include positive train control (PTC) systems, intelligent transportation systems and

GPS/AVL. Some of these applications will doubtless involve satellite communications technology.

Much of the radio infrastructure for a railway system is made up of dispatch centers and maintenance vehicles similar to those found in public safety or public works applications. But the locomotive is a different animal. The working environment for train-mounted railroad radios is filled with ambient noise up to 90dB, vibration and myriad safety concerns. The radio has to fit in a moving workstation filled with other more critical, mission-specific equipment. Headphones and speakers require sufficient frequency range to be audible (250Hz-4,000Hz), and microphones require dynamic range to be sensitive (50dB variations). These levels are necessary to provide output and input of voice communications against the background noise. Headphones may need to be capable of routing cabs alarms that normally issue through speakers, and level amplifiers may be needed. Squelch control with a manual override is also a prerequisite in this environment.

Because of a variety of voice radio disadvantages in this environment, data links have been advocated to make communications safer and more efficient. Voice channels may be congested, because they are also used by yard masters, terminal switching crews and maintenance-of-way crews. This heavy use increases the likelihood of miscommunication between dispatch and the train crew (and FRA regulations require any garbled radio message to be *ignored* by the recipient). Overlapping signals between neighboring dispatcher districts, incompatible radio systems



within dispatcher offices, and malfunctioning or disabled radios in the locomotive are also cited as reasons for increasing the use of data. Low-priority messages that can be diverted to data transmission alleviate voice channel congestion. Because data messages can be displayed by LCD, VDT or other means, the crew doesn't have to memorize the message, and the information can be saved on the train's onboard computer. This would eliminate the current FRA requirement to make a hard copy of all radio orders.

However, voice radio communications will still be required for priority communications, such as departures from normal operations or emergencies, and in cases of data system failure. Voice retains other advantages as well. As in public safety communications, train crews get aural cues from dispatch—they can read the speed, intonation and urgency inherent in voice. Broadcast (shared) dispatch also means that the train crew is aware of other activities and potential situations involving other train crews and locations.

#### Evolving federal regulations

The extent to which mobile radio communications permeates railroad work is not appreciated without a look at federal railroad communications regulations. In the last quarter of 1998, the FRA revised the railroad communications rules in Part 220 of 49 C.F.R. The transition period for adherence to the updated rules becomes complete in two months, July 2000, at which time smaller railroads will have to be in compliance with all sections. Large railroads (greater than 400,000 annual employee hours) fell under the rules in 1999.

A thorough reading of the rules is recommended to anyone providing services to railroad communications. (Many of these rules are reinforced or surpassed by American Association of Railroads [AAR] standards and individual railroad work policies.) Several points deserve specific mention:

► **Definitions** — FRA has changed the term "radio communications" to "wireless communications," and added definitions of "working radio" and "working wireless communications" to the regulations. These definitions include the capability to transmit and receive communications between any location in the railway system and the control center (with the aid of repeaters).

► **Redundancy** — All passenger trains, regardless of the size of the railroad, have to be equipped with a working radio in the occupied controlling locomotive and with redundant working wireless communications equipment.

► **Support crews and equipment** — Each piece of independently powered maintenance-of-way equipment must have a working radio and the capability to communicate with other equipment in the work group. Each worker responsible for on-track safety of a roadway work group and each lone worker must have access to a working radio.

► **Reliability** — Every radio, and the redundant equipment, must be tested before starting a work shift, and any non-functioning equipment must be re-

moved from service and replaced. Dispatch must also be notified of failures.

Additional rules changes affect radio operating procedures for worker safety.

#### Refarming and narrowbanding

Railroads operate voice analog FM networks at 160MHz. With 25kHz bandwidths, this gave the industry 91 channels, which are frequency-coordinated by the AAR through its wholly owned Transportation Technology Center Inc. (TTCI) subsidiary. These VHF highband networks are licensed to and managed by the individual rail companies. They are



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Maintenance and support vehicles, and all lone trackers workers, are required to be equipped with mobile radios when in an active train operations area.

also interoperable for run-through trains and joint operations.

Railroads also have access to three RF channel pairs at 450MHz. These are used for two-way end of train (EOT) devices, which essentially eliminated the need for the traditional caboose. Six channel pairs, licensed to AAR, at 900MHz have also been authorized by the FCC for new electronic train control applications. These 900MHz channels are being used for control and monitoring. For example, digital applications handle work-order reporting and data communications between signal systems and dispatch centers.

In its infamous, extended refarming process to promote narrowbanding, the FCC acknowledged railroads as a special case within the industrial pool (based in part on the safety applications of railroad spectrum) and allowed the railroads to retain exclusive frequency coordination. AAR is also one of only

three frequency coordinators that have entered into a Memorandum of Understanding with the FCC's Enforcement Bureau to prescreen and attempt to resolve interference complaints among its own industry users.

Refarming presents both opportunity and challenge for the railroad industry. It will allow railroads to double their number of channels, use trunked networks and restructure channels to accommodate present and future communications needs. However, the challenge will be to perform those functions correctly to avoid technical errors and expensive solutions.

Refarming requires that new FCC type-certified radios meet 12.5kHz channel width requirements. Railroads can continue to use 25kHz radios already in service. For the railroads, refarming has meant an increase in the number of channels at 160MHz from 91 to 182, requiring a new channel plan. To



enable refarming, and to provide for data capability, AAR created a Wireless Communications Task Force (WCTF) that developed a band plan that has been accepted by the FCC. The plan calls for 10 eight-channel duplex, trunking blocks bracketing a 52.5kHz band that could be used for simplex communications. The eight-channel blocks would be located at base stations, and both the transmit and the receive channel would be located at repeater sites.

The WCTF has also selected Project 25 (TIA-102) technology for use by the railroads as an interoperable, integrated voice-plus-data standard. The Project 25 standard is being used in a pilot program funded by the FRA through the Oregon Department of Transportation. The study will evaluate the technology as a potential VHF data link for train control operations.

Interestingly, railroad-provided Project 25 radios were used by the NTIA's Institute for Telecommunication Sciences in 1998 to evaluate the audio quality of radios conforming to the standard. Therefore, the railroad industry may find the sensitivity and speech quality assessments of that report particularly useful.

The FRA, in its oversight role, wanted to ensure that railroad communications would not be degraded by adoption of the WCTF band plan or by the use of Project 25 technology. It commissioned the ITS to assess the technology and the rechannelization plan in terms of equipment performance, channel assignments and system capacity, interference issues and radio coverage. One recommendation of that report was to avoid adjacent-channel interference and intermodulation interference that might be created by co-location of multiple channels and frequency assignments. Because Project 25 radios are designed with 12.5kHz bandwidth, but railroad VHF channels are spaced every 7.5kHz, the ITS study recommended that transmitters in neighboring regions be offset in frequency by at least two channels.

TTCI is also developing a "Frequency Application and Management System" to deal with an increasing volume of frequency coordination requests and cut administrative costs.

AAR/TTTCI and the North American Joint Positive Train Control Program are also cooperating to develop a "spectrum management tool kit." The software will use algorithms and database applications to predict the coverage of radio transmission stations using various frequencies, modulation techniques, antenna types, tower heights and

transmitter power ratings. The tool kit will integrate geographic information system (GIS) technology for mapping antenna locations and rail lines, as well as estimated RF coverage.

Railroads are actively pursuing the goals they need to modernize and improve radio communications. The radio industry now must support their efforts. ■

#### Selected references

1. Multer, Jordan, Robert Rudich and Kevin Yearwood, "Human Factors Guidelines for Locomotive Cabs," Federal Railroad Administration, Nov. 1998.

2. Moody, Howard, Robert Gallamore and Edwin F. Kemp, "Radio Frequency Management: What is Going on in Railroad Radio Communications?" AAR Transportation Technology Center Web site, [www.aar.com/TTC/Communications/comm.html](http://www.aar.com/TTC/Communications/comm.html).
3. Vanderau, John M., "Delivered Audio Quality Measurements on Project 25 Land Mobile Radios," Institute for Telecommunication Sciences, NTIA, Report 99-358, Nov. 1998.
4. Vandea, John M. and E. J. Haakinson, "An Evaluation of the Proposed Railroad VHF Band Channel Plan," Institute for Telecommunication Sciences, NTIA, Report 99-370, Sept. 1999.
5. "Implementation of Positive Train Control Systems," Report of the Railroad Safety Advisory Committee to the Federal Railroad Administrator, FRA, September 1999.

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# Radio Renaissance

*IWCE conference sessions and technical exhibits underscore the comeback of land mobile radio. A new public safety track and live Web coverage herald a fresh look for the industry's longest-running trade show.*

Compiled by the *MRT* editorial staff

Whether attendees were shopping for equipment, searching for technology enlightenment or simply seeking insight into the land mobile radio industry, IWCE offered something for everyone. In its 24th year, the International Wireless Communications Exposition (IWCE) retains the title of the longest-running trade show in the mobile radio marketplace. At IWCE 2000, March 22-24, nearly 10,000 attendees swarmed the session rooms and visited 364 exhibits across 100,000 square feet of booth space.

Along with these traditional show elements, IWCE 2000, which is sponsored by Intertec Publishing's wireless communications magazines, introduced public safety sessions in the conference and live Internet coverage from the show floor.

Exhibitors and attendees reported favorably on the show's content and overall quality. For example, Mike Wiggington, general manager of Total Page, found exactly what he was looking for at MCM Technology's

booth in the way of real-time software. The only problem? "Every time we went by the booth, they were stacked two or three deep."

## Opening-day activities

Robert H. Schwaninger Jr., *Mobile Radio Technology's* regulatory consultant, returned for a second year to headline the opening session. Schwaninger, a Washington-based telecommunications attorney and general counsel to Small Business in Telecommunications, lampooned the FCC and popular television with a slide presentation of "Who Wants to be a Commissionaire?" Questions focused on FCC commissioners and featured such queries as: "For \$500,000, choose the dumbest thing ever said by an FCC official."

Schwaninger urged attendees to ignore industry observers who predict the decline of opportunity in the land mobile arena. "I have to laugh every time someone predicts your demise," Schwaninger said. "Radio people don't go away. After a nuclear war, there will be two things left: the roaches and the radio guys."

Stephan Beckert, director of dispatch and data for The Strategis Group and member of *MRT's* editorial advisory board, shared his prospects for data, private radio and SMR. His presentation supported Schwaninger's stance that this industry is stable and growing.

Beckert said that although some refer to land mobile as a "dinosaur," attendees should remember: "Dinosaurs walked the earth for a couple of million years before we did," and land mobile has longevity as well.

## New in 2000

A new public safety track complemented the conference's traditional business, regulatory and technology portions of the educational program. The additional sessions, which covered such topics as "Comparing Conventional and Trunked Land Mobile Radio Systems," "Enhanced GPS for Public Safety Applications" and "Wireless Communications Interoperability—A Growing Problem," were the most highly attended.

"I'm glad to see the public safety



track in the IWCE conference," said Jay Smith, supervisor of electronics for the City of Minneapolis. "I've been coming to IWCE for five years. I've seen that the show is heavy in business communications, and I like the new emphasis on public safety."

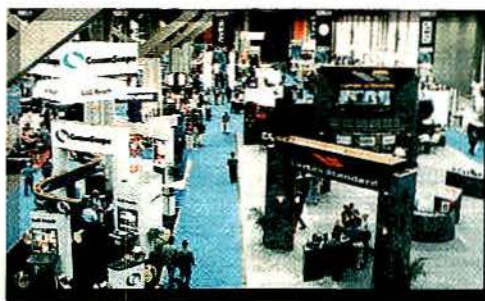
Based on such positive attendee response, plans for next year are to expand the track and continue increasing focus on public safety issues.

IWCE Live!, a feature introduced by the *MRT* editorial staff and Intertec Exhibitions, represented another significant "first" at IWCE 2000. This Web site served as a live news source for company announcements, product releases and industry trends revealed at this year's show. While show organizers added attendee testimonials and daily conference updates, *MRT* editors filed exhibitor and attendee interviews, editorial commentaries and breaking news literally from the show floor. The site, found at [www.iwceconexpo.com](http://www.iwceconexpo.com), will be accessible throughout May.

#### Some words from the FCC

The FCC Roundtable and Forum provided a venue for attendees to hear

the latest FCC activities. Attendees questioned FCC staff members on upcoming FCC auctions, telephone "hotline" support, FCC Internet initiatives and the outcome of Y2K issues. Moderated by Don Bishop, editorial



director of *MRT* and *Site Management & Technology*, the session's panel included Kathryn Garland, Steve Miller and Roger Noel from the FCC.

The "electronic FCC" was another topic of discussion. This new effort is centered around the Universal Licensing System (ULS), the core database that acts as the regulatory agency's license filing, research and data storage tool. Licensees can renew licenses, apply for new ones and transfer license

ownership as well as retrieve various data in Technicolor graphic formats.

The FCC is requiring all commercial license holders to submit their paperwork on-line. Although there are some exceptions in the realm of private radio, those who don't register with the FCC's on-line service simply aren't going to be doing business with the FCC anymore, said Noel, chief of the Wireless Telecommunications Bureau's licensing and technical analysis branch.

Although some licensing aspects haven't made it on to the ULS, such as antenna registration and complaint filings, Noel said it is only a matter of time before the FCC is completely electronic. Currently, the ULS is only accessible through the FCC's wide-area network. Noel said that the FCC plans to have the entire ULS on the Internet by summer.

#### Other IWCE highlights

Industry veteran Marty Cooper, chairman of ArrayCom, San Jose, CA, addressed guests and members March 23 at a breakfast meeting of the Radio Club of America. Cooper spoke to a

## ITA paves the way on 700MHz, but will it play?

In an informal press conference at IWCE, Industrial Telecommunications Association (ITA) President Mark Crosby discussed the licensing and operations rules for the 700MHz guard band allocations approved by the FCC's Second Report & Order (R&O) issued earlier in March.

Crosby declined to confirm whether ITA definitely will be a participant in the auction. However, he said that the association is actively performing due diligence to determine the feasibility of its participation. ITA worked closely with the FCC on the creation of the "guard band manager" (GBM) licensee category created by the Second R&O.

"That would be a wonderful result," Crosby said. "But it's certainly not a 'slam-dunk.'"

Qualifying short forms were due in early May and the auction is scheduled for June 14. At stake are two allocations, one of 4MHz and one of 2MHz, that bracket and "guard" 24MHz of public safety spectrum already allocated. (See "FCC Notes," page 58.) Public safety is being guarded from potential interference from commercial service in adjacent blocks of spectrum (30MHz total) that will be auctioned June 7 (postponed by the FCC last week from May 10). To facilitate that protection, the Second R&O restricted use of the guard bands to non-cellular system architectures, giving an edge to site-based land mobile operations for private internal wireless and private carriers.

Both auctions are on a fast track to meet a congressionally mandated deadline to place derived revenues in the U.S. Treasury by September 30. All the 700MHz allocations

are in spectrum currently occupied by UHF broadcasters that will migrate out of the band over the next few years to new DTV assignments.

The GBM classification introduced in this auction probably will be applied to future spectrum allocations, based on multiple references to the concept in spectrum management hearings and documents, Crosby said. "When you see it coming out of the commission every six weeks, you think 'They must really be on it,'" he said, agreeing that the concept fits with ongoing FCC migration toward privatization of licensing and other activities. ITA, for example, is one of three frequency coordinators already cooperating with the Enforcement Bureau under a Memorandum of Understanding to mitigate interference complaints among licensees.

The number and type of contestants to become GBMs in the auction is still hazy. Only GBM prospects will be allowed to bid, according to the rules in the Second R&O. GBMs will act as spectrum brokers, leasing spectrum to third parties for profit, and they will only be allowed to assign 51.1% of their auction award to "affiliates." The remaining channels won must be disaggregated.

Speculation is wide open as to who will participate. "Organizations, entities, will 'dive out of the sun' on you," Crosby said. "I'd hate to even venture a guess."

However, eliminating some unlikely prospects is easier. Crosby expressed doubts that any major radio manufacturers will be interested, based on their divestiture of licenses, tower sites and other non-product sources of income over the past few years. "The profit is in the equipment," he said. He added that the rules prohibit proprietary architectures and make participation less

attractive as a manufacturer business strategy. Where will money come from to fund GBM candidates? Crosby suggested possible sources include venture capital, loans or private equity.

#### Crossing the River Jordan

Crosby agreed that if, after its due diligence, ITA decided against participation in the auction, it would be detrimental to the process it helped to create. "I think ITA has to do everything it can to participate. I don't particularly like to fail. If I fail, I at least want to participate. If I fail at the auction—so be it. ITA has spent a lot of time—a lot of time—on this." However, ITA itself may not be the actual bidder, but rather it may be an affiliation or separate entity created to be a band manager, Crosby hinted. "I don't want to create any appearance of impropriety inside of ITA," he said.

Crosby also said successful GBM candidates will have to take seriously the obligation to prevent interference with the public safety allocation. Coordination efforts for a GBM do not solely involve the main public safety frequency coordinator, the Association of Public Safety Communications Officials—International (APCO), Crosby said. "It is APCO—but it's also DOJ, Treasury—there are other players involved, in addition to APCO," he said. "If I were a guard band manager, I would want to sit down with everybody and say 'This is my strategy to protect you.'" He said the proximity of the 6MHz of guard bands to public safety activity will make that cooperation more intense than frequency coordinators currently experience. —D.K.



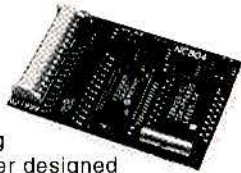
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packed room, discussing today's available wireless technologies and predicting the telecom industry of tomorrow.

Cooper said that the wireless telecom market of the future will be Internet and consumer-oriented. Rather than having a single entity as a provider, there will exist an open platform for thousands of entrepreneurs who can provide a service to society and make some money while doing it, he said.

Also on March 23, more than 75 attendees participated in the second annual Simulcast Forum sponsored by Simulcast Solutions. Participants heard from speakers who shared personal experiences with this technology. Walter Rheingans of San Luis Obispo shared his experiences in upgrading a radio system using Mastr III base stations and Motorola/Premisys multiplexers. Hans Bakker provided first-hand information about the Los Angeles County Fire Project, which used Motorola Micor base stations at all 13 sites.

Luciano Battaglia of Prod-El shared how simulcast is accomplished in Italy and other parts of Europe. Joe Blaschka of Adcomm Engineering ended the morning's forum by describing his recent digital paging system project at Oreille County Washington and the Tait Electronics simulcast system being installed in Thurston County Washington.

A Simulcast Forum East is scheduled during the August APCO Conference in Boston. For more information, contact Ed O'Connor at his email address: [ed@simulcastsolutions.com](mailto:ed@simulcastsolutions.com).

## Build it, and they will come

Nothing draws a crowd of attendees together faster on a show floor than cool promotional "giveaways" or an unusual booth. This year, Motorola's stadium booth, which supports its NFL partnership promotional theme, attracted a steady stream of visitors.

"All of our promotions that we're running, whether trunking, conventional or rebates to the dealer channel, carry the theme of our NFL partnership," said Craig Chenicek, senior product manager, North America Radio Products Division for Motorola's Commercial, Government and Industrial Solutions Sector.

It was in this setting that Motorola introduced its line of new products for conventional and trunked service. Motorola conducted training sessions for its dealers before IWCE, explaining the new products, the rationale behind them, and roadmaps and visions for each market. Chenicek said that with its

## Hitachi invests in ComSpace

Hitachi Denshi Ltd., a Tokyo-based affiliate of Hitachi Ltd., has invested in ComSpace, a Dallas company that is developing a spectrum-efficient two-way radio communications technology. The technology uses digital modulation to place as many as eight voice channels into a 25 kHz-wide bandwidth, the same bandwidth that would be taken by a conventional frequency-modulated voice channel.

The equity investment is only a few percentage points, "but it is the first time we have invested in a foreign company," said Kazuo Suzuka, general manager of Hitachi Denshi's Land Mobile Radio Division.

The ComSpace technology is called digital-channel, multicarrier architecture (DCMA). In Japan, Hitachi Denshi offers frequency-division, multiple-access (FDMA) land mobile products with utility companies as foremost customers, and time-division, multiple-access (TDMA) land mobile products with local government agencies as primary customers.

"With DCMA, we now have three technologies for digital migration in Japan," Suzuka said.

Hitachi Denshi previously agreed to supply ComSpace with DCMA product as an original equipment manufacturer.

ComSpace President Steven E. Fulford said: "Hitachi has taken the next step in bringing DCMA to Japan and the Asian market. We are pleased to have such a prestigious company as a partner and investor."

(An expanded story on this subject can be found on the "Online extras" page at [www.mrtmag.com](http://www.mrtmag.com).) —D.B.

product introductions, Motorola wants to communicate that it understands the viability of the two-way radio market.

Radio Frequency Systems' booth proved to be another "crowd pleaser." The company's "Ride the New Wave" theme tied in with its wave-shaped logo and the merger of its two divisions, Celwave and Cablewave. At the booth, attendees posed on a surfboard and got their photos taken. The photos were digitally processed into a postcard to send home.

Radio Frequency Systems is banking on increased market share, buildouts on new frequency allocations and conversions to digital systems to bring it sales growth in the land mobile radio industry. Andrew Singer, director of marketing and technical services for the company's RFS America business unit, said that the company is now a single-source provider.

"Customers appreciate that they can reduce number of suppliers. We provide training, products and ideas for the system solution. It's working out very well," he said.



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## RF Industries sees increases through general distribution

RF Industries, San Diego, has benefited from a 65% increase in net income to \$220,000, for its first quarter ending Jan. 31, compared to \$134,000 for the same quarter last year. Net sales advanced 32% to \$1,760,000 compared to \$1,331,000 last year.



Hill

"Strong shipments of RF coaxial connectors and cable assemblies enabled RFI to post its fifth consecutive quarter of increasing sales," said Howard Hill, president. "With the addition of several new distributors for coaxial and connector products, coupled with our efforts to increase OEM sales, we are optimistic that the RF Connector Division will have a record year."

Les Perlman, vice president of sales and marketing for RF connectors, said that the company's new distributors are performing well. He added that improving market demand for passive electronic components and interconnect products make for a good year for distribution.

Richard LaFay, president and general manager of the RF Connector Division, said, "We are encouraged by strong sales across our product line and the significant contribution being made by cable assembly products, which now account for 10% of the connector division's sales."



LaFay

RF Industries' Neulink Division, which makes wireless modem products, has added store-and-forward, broadcast mode and TCP/IP engine en-

hancements for its SS9600 2.4GHz spread-spectrum modem. The improvements allow the modems to be programmed to store and forward their own data and to relay data from other modems. The effect is to increase transmission range without increasing power, thereby maintaining compliance with FCC license-free requirements.

"Land mobile hit a slump for a couple of years," Hill said. "It seems to be picking up now. There was a slump in 1999, a year that ended down 4% in sales. It was really bad in our second quarter, February to April."

The company introduced land mobile radio products to fit Andrew, Cablewave and Eupen cables, but they didn't sell well.



Perlman

"Similar products designed for Times Microwave Systems cable did okay," Hill said.

Hill said that the company has added large distributors for its general line of industrial connectors that sell more to OEMs than to two-way radio customers. Its large two-way distributors, including Electro-Comm Distributing, Hutton Communications, Talley Communications and TESSCO Technologies, are expanding their market to include smaller OEMs.

Perlman added that once distribution sales picked up momentum, the company started getting inquiries from other large general line and catalog distributors.

RF Industries wants to interest manufacturers' representatives in its Internet spread-spectrum 2.4GHz link

product for the monitoring market. Hill said that applications range from refrigeration cars to gas wells to seismic monitoring.

"What's nice about the spread spectrum is that it is non-licensed," Hill said. "It has a storage capability to use as a repeater that gives it extra range without extra wattage."

Hill said that distributors had not been interested in the product because, in contrast to connectors, the link is not something that can be taken off the shelf and shipped. "There's some customizing to it." He said that the company had tried to interest major distributors, but the product never really moved out.

Hill said RF Industries views representatives as conduits of information to engineers.

"The reps are beating the bushes with other products under the same umbrella with wireless products. They run across applications with OEMs and end-users," Hill said.

RF Industries is now looking at possible mergers and acquisitions after renewed power in its shares, Hill said. The stock price rose from \$2 to \$16 before settling back to \$8 in the past few weeks.

"We're fairly cash-rich," he said. "We have \$3.5 million in cash with no debt."

Hill attributes the company's progress to customer service, good-quality products and good prices.

"We smother our customers with service. One compliment is that they hear more from us in a week than they hear from our competitor in a year. That's what we live by," he said. —D.B.

## Relm compensates Simmonds; completes asset purchase

Relm Wireless has signed a contract to compensate Simmonds Capital Ltd. (SCL) for strategic consulting and advisory services, which includes helping it acquire rights to private radio products made by Uniden America and for ongoing advice about Relm's business development. The compensation includes 150,000 common shares of Relm stock, valued at \$724,000 (or \$4.82 per share on March 29, the date of announcement). The share price had dropped as low as \$3 on April 4. SCL further receives

warrants to purchase 300,000 common shares at \$3.25 per share. SCL's expenses will be reimbursed with another 50,000 shares and an unspecified amount in cash.

Another 300,000 shares go to SCL to pay for inventory, tooling and related Midland International intellectual property rights for radio communications products sold outside of the United States. Inventory and tooling are housed at a Hitachi Denshi facility in Japan.

The total value of the 500,000 shares

going to SCL is \$2.4 million at the March 29 price; at \$3 per share, they are worth \$1.5 million.

SCL also has purchased a convertible note for \$200,000 as part of a private financing placement by Relm.

Relm has an estimated five million shares outstanding. Although SCL may have purchased shares not included as part of these transactions, the 500,000 shares it is acquiring through Relm's compensation for advice, assets and expenses may allow SCL to control about 10% of the company. —D.B.



## Marketronics builds Florida network, distributes Securicor products

Marketronics, Sunrise, FL, has placed an order worth \$2 million with Securicor Wireless for products and services to build a 220MHz network in southeastern Florida. Securicor Wireless, a subsidiary of Securicor, Surrey, United Kingdom, has its headquarters in New York and its operations center in Kansas City, MO.

Securicor Wireless and its partner, the National Rural Telecommunications Cooperative, have national and regional licenses for a large number of 220MHz commercial mobile radio channels. Under a contract with Securicor, Marketronics will have the right to use 30 to 40 of those channels to cover a population of five million people from West Palm Beach to the Florida Keys. Marketronics will own and operate the network and will sell radio communications products and services under the Securicor Wireless name.

The network may include a few existing operational sites and new construction, and it may be activated as soon as the end of July. Marketronics will add as many as eight employees in its U.S. offices for technical support, system engineering, sales and marketing.

Marketronics has been known as an international distributor, carrying products from more than 100 manufacturers. The company also has experience in configuring paging and trunked radio networks. It owns community repeaters in Latin American countries.

Marketronics' president, John Kelly, said that the company has done business with the U.S. radio equipment sales and distribution unit of Securicor Wireless since the mid-1980s, when the unit was part of Midland International. It began selling what now are Securicor Wireless automatic vehicle location (AVL) and mobile data products about eight years ago, several years before Securicor Wireless' predecessor company, Intek Global, bought the business known as Data Express from another company, Mobile Data Solutions. Kelly said that Marketronics had been one of Data Express' largest distributors.

The greater opportunity lies in AVL and data compared to voice communications, Kelly indicated. He said that network sales would concentrate on fleet owners, such as ambulance and regional delivery services, that have vehicle status and AVL requirements.

"We are currently developing our marketing plan and identifying specific users we feel will benefit from the ser-

vices we will offer. Our emphasis will be on demonstrating the advantages of mobile data vs. traditional voice dispatch," Kelly said.

Marketronics is motivated by the potential for recurring revenue in air-time sales in southeastern Florida and internationally.

In addition to the Florida network, Marketronics and Securicor Wireless expect to launch similar networks to sell products and services in Latin America and the Caribbean, where Marketronics has offices in Mexico City; Sao Paulo,

Brazil; and Santiago, Chile. The company's agreement with Securicor Wireless gives it rights to distribute Securicor Wireless' products throughout the United States, Latin America and the Caribbean.—D.B.

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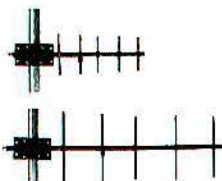
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## FCC Notes

### Getting the 700MHz game on the road

Activities in the doubleheader auctions to license 700MHz spectrum include game delays, substitutions in the lineup and change-up pitches. The FCC postponed the 30MHz allocation for commercial service auction (747MHz-762MHz and 777MHz-792MHz) from May to June to allow both bidders and the agency to get their game together. The revised schedule: April 24, auction seminar; April 25, orders for remote-bidding software; May 8, Form 175 filing deadline; May 22, upfront payment deadline. A mock auction on June 2 precedes the real thing on June 7.

### Lowering the taxes on Tara

Meanwhile, the 700MHz guard band auction follows on June 14, offering a total of 6MHz designed to protect public safety bands. One "A block" 2MHz license (paired 1MHz blocks) and one "B block" 4MHz license (paired 2MHz blocks) will be offered in each of the 52 major economic areas (MEAs). Key dates preceding the auction had just been posted by the FCC at press time. The schedule: April 27, auction seminar; May 9, Form 175 filing deadline; May 26, upfront payment deadline; May 30, order deadline for

remote bidding software. A mock auction on June 12 precedes the actual auction.

The auction is restricted to the new guard band manager (GBM) licensee category. Rules comments focused on the high upfront payments (UFPs) and minimum opening bid (MOB) requirements. Industry associations and potential bidders unanimously called for a reduction of the amounts. The FCC's auction prices, set by the WTB, called for A and B block UFPs as high as \$623,000 and \$1.25 million, respectively. Similarly, MOBs topped out at \$1.87 million for the A block and \$3.7 million for the B block.

Several comments filed on the auction rules pointed out that the bid levels would deter, if not exclude, small business. Commenters said that factors that would decrease the value of the spectrum include incumbency on the bands by UHF-TV stations until 2006, interference protection from commercial users in the other 30MHz allocation and provisions for interference protection for public safety users. Commenters said the FCC should not expect GBMs to have deep pockets.

ITA noted that population may not be the appropriate economic platform on which to establish MOBs, given the "practical realities" of GBMs providing interference protection to public safety. Mobex Communications said

the thresholds were "cost-prohibitive for most small businesses." Mobex noted that the minimum aggregate value that the FCC had placed on the entire 6MHz was \$48 million, with an average bid for each MEA (A and B blocks) of about \$469,000, "just to participate" in the auction, let alone to register a winning bid. AMTA said the rates would "preclude auction participation by the very entities the FCC anticipates will elect to pursue guard band manager roles."

Motorola proposed a valuation formula, similar to that used for the 220MHz auctions, whereby MOBs would be calculated at a dollar value multiplied by megahertz and by license population. UFPs would be about one-third of the MOB for an MEA. The proposal would reduce the original entry levels for the auction by two-thirds. Reply comments by ITA, Mobex and AMTA all endorsed the Motorola proposal.

### Yes, Virginia, there is an FCC

At press time, the FCC acquiesced to the commenters' points and, in an April 10 auction notice, reduced the levels for UFPs and MOBs to about one-third of the original postings. This puts the average UFP for an MEA at \$104,410 and the average MOB for an MEA at \$312,670.

—D.K.

## Knight's Communications resumes business as two-way radio dealer

Knight's Communications, Ft. Worth, TX, is set to re-enter local radio communications sales and service after a five-year absence. Its hiatus was required by its agreement not to compete with Pittencreif after it sold the company its SMR systems in 1994. Pittencreif's SMR systems later were acquired by Nextel Communications.

Knight's has a 50-year association with Com-Net Ericsson Critical Radio Systems and its predecessor companies, Ericsson Private Radio Systems and General Electric Mobile Communications. Since the sale of its SMR systems, Knight's has continued to provide installation and maintenance services for

Com-Net enhanced digital access communications systems (EDACS).

The president of Knight's Communications, Bob Brandt, purchased the company in 1989.



Brandt

"In 1996, we added products and services for the broadcast and professional audio markets, including Fibox products from Lightwave Systems and matrix switchers from Lighthouse Digital. Knight's has sales agents that cover China and South Korea," Brandt said.

In 1998, the company added cable products from Mohawk/CDT, allowing

it to quote directly from the manufacturer with standard or custom cable designs. Also added were products from digital video manufacturers AJA Video Systems and Ensemble Designs. The company installed its first data LAN system in 1998.

"Broadcast, audio and video equipment sales are going well, but the market is slow to penetrate. We're finally turning the corner, and although we can't subsist on those sales alone, we're getting better leads and contacts now. Sales in China are picking up," Brandt said. "We are excited about growing our local presence and getting back into day-to-day service."

Knight's wants to begin by selling Com-Net's conventional two-way radio products to large users with internal systems, such as universities and industrial users.

"We've sold to them in the past, and my focus now is to get back with those people and re-establish connections."

Brandt is positive about Com-Net's purchase of Ericsson's private radio systems business.

"No one will invest that amount of money and then let it wither away. Com-Net's upper management seems committed to bringing new conventional products, which is good. There's no opportunity for us to sell EDACS trunking, so without a good

conventional line, there's nothing to sell with Ericsson. We've been associated with the Ericsson genealogy for 50 years, and we would like to stay with them. So many other dealers have multiple product lines. We have other revenues with Ericsson, so we haven't had to do that. It has been enough to keep us alive, though barely. If you look at other Ericsson dealers, they're selling Kenwood, Vertex and other brands. We haven't had to do that," Brandt said.

Brandt said that Knight's went back into the dealer business, at a time when some dealers found it favorable to exit, because the company needed the local sales and service to fill in the gaps of doing systems installations for Com-Net. He estimated that conventional equipment sales might add \$200,000 per year to Knight's revenue, helping to supplement its other revenue sources.

Knight's is looking for airtime access, whether through existing networks or building its own. Brandt mentioned the possibility of placing users on the 220MHz network operated by Incom in the Dallas-Ft. Worth metroplex, although he said its coverage may limit sales to the middle part of the area.

"Any other players here that would welcome us are so small, they are maxed out anyway. I'm not interested in being a Nextel reseller," Brandt said. —D.B.



## Relocation, spectrum opportunities highlight SBT's pre-IWCE seminar

Relocation issues at 800MHz, auction updates, interconnection agreements and tower site management topics highlighted the second midyear meeting of Small Business in Telecommunications (SBT) in March. About 100 association members and telecommunications small-business people attended the five-hour seminar, held one day prior to IWCE 2000 in Las Vegas.

Lonnie Danchik, SBT chairman, noted that although the seminar was billed as "Jam II," after 1999's "Jam Session," some attendees had mistakenly read the invitation as "Jam It," in keeping with SBT's feisty attitude toward regulation and small business.

As a follow-up to a presentation at SBT's 1999 annual meeting in St. Louis, Sandy Edwards of Nextel Communications discussed his company's plans for relocating, or retuning, incumbent 800MHz licensees from channels that Nextel had won at auction. A healthy debate emerged from the floor, with attendees quizzing Edwards on specific per-unit retuning costs. Although Nextel's presentation to SBT six months prior had

focused on outright purchase of incumbent systems, Edwards said the current philosophy is to negotiate a retuning solution. Because the upfront costs for retuning are paid by the incumbent and later reimbursed by the auction winners, some attendees expressed the opinion that the new approach was one way to lower prices for outright system buyouts.

Earlier in the program, SBT counsel Robert H. Schwaninger Jr. pointed out that SBT still had an appeal of the 800MHz auction proceedings pending in federal court. He noted that the FCC had not detailed any specific penalties for failure of good faith negotiations in the 800MHz relocation timetable.

A surprise visitor to the seminar was Industrial Telecommunications Association President Mark Crosby. He discussed ITA's efforts to secure additional spectrum for private wireless, including the pending 700MHz guard band auction. Crosby said other possibilities, such as proposed allocations between 1,390MHz and 1,435MHz, were less promising because of incumbent government systems. He noted that U.S.

Senate bill S. 1824, to provide private wireless spectrum, still lacked a companion bill in the U.S. House of Representatives. Crosby discussed various strategies to relocate UHF-TV stations out of the 700MHz band earlier than the statutory 2006 deadline.

Vic Jackson, of Vic Jackson Interconnection Services, in a presentation titled "Phoney Business," discussed the status of LEC reimbursements to paging carriers and rate structures for negotiating interconnection agreements.

Attorney Michael L. Higgs Jr., of Schwaninger & Associates, discussed reversion contracts for tower sites and ways to leverage tower leases into other investments or capital improvements. Higgs estimated that, despite the acquisitions of the "big five" tower companies, only about 20% of the entire tower market has been consolidated.

Corporate sponsors and presenters at the seminar included Communications Research, ComSpace, DX Radio, Kenwood Communications, First Contact, John Furr & Associates, IDA, Multiplier Industries, PCIA, Primus Electronics, Ritron and Trident Micro Systems. —D.K.

## Transcrypt's losses decline, wireless product sales dominate

Transcrypt International's annual report, released March 23, expresses hope, describes new product development and enumerates declining losses. The Lincoln, NE-based company continues to take steps to overcome the adverse effect on its relationships with customers and vendors stemming from its 1998 restatement of its results for 1996 and 1997. The restatement, which reduced reported revenue by \$1.7 million, brought class-action lawsuits, drew an investigation by the Securities and Exchange Commission and adversely affected the company's business, financial condition, results of operations, liquidity and cash flows.

Revenues declined by 14% to \$53.5 million in 1999 from \$62 million in 1998. Of total revenues for 1999, the wireless communications segment comprised 85.8%, and the information security segment comprised 14.2%. On a positive note, though, and reflecting its ongoing recovery from the 1998 restatement debacle, the company's revenues have increased quarter-to-quarter after the

first quarter of 1999, ending with \$15.8 million in revenues during the fourth quarter of 1999.

Although Transcrypt's domestic commercial sales declined 40% between 1998 and 1999, the company anticipates that its revenues soon will stabilize at 1999 levels and then begin to grow.

The company's R&D expenses declined in 1999 as it reduced and divided its engineering staff between its E. F. Johnson subsidiary and Secure Technologies division. A continuing new product development process initiated in 1998 requires smaller resources and is intended to speed the delivery of products to market.

Transcrypt's results can be interpreted in several ways. For example, the company had a net loss of \$3.8 million during 1999. However, this amount includes a \$0.5 million restructuring expense and \$2.2 million of income from a reduction in a litigation reserve set up during the previous year. Without these two items, the net loss would have been about \$5.5 million.

During 1998, the company lost \$22.2 million, which included \$1.2 million of restructuring charges and a

\$10 million provision for litigation settlement. Without these two items, the company would have had a net loss of about \$11.4 million (net of tax benefit).

During 1997, the company had a net loss of \$10.9 million, which includes a \$9.8 million charge for in-process research and development. Without this item, the company would have had a net loss of about \$1.6 million (net of tax benefit).

Transcrypt makes wireless communications products and systems and information security products. Its communications products include land mobile radio base stations, mobile radios and portable radios, and complete communications systems. It sells radio products and systems to commercial users and to public safety and government users.

Its information security products prevent unauthorized access to sensitive voice communications. These products, which use analog scrambling and digital encryption technologies, are sold to the land mobile radio and telephony security markets. —D.B.



## Base station antennas

### Antennas offer 8dBd gain

The lightweight, compact Broadband Collinear Array antennas from **TX RX Systems** are available in 450MHz to 512MHz and 806MHz to 960MHz frequency ranges with versions in downtilt or inverted mounting. These rugged antennas offer an exposed dipole array and radome for weather resistance. Features include 8dBd gain, 10° beamwidth, 1,000W power rating and a 225mph wind velocity rating.

Circle (351) on Fast Fact Card

### Unit combos two antennas in one

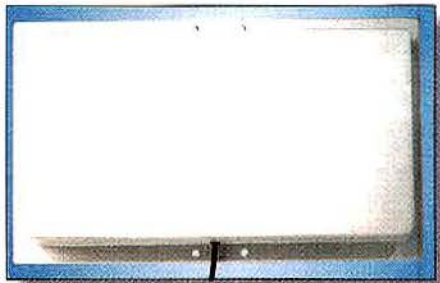
Harmony antennas from **DAPA** incorporate two dual-polarized antennas under the same radome, thus allowing the use of one ground plane to support both bands. This design reduces total weight and windload, and delivers expected transmission without increasing transmitting lines. The dual-band antenna is really two slant 45 antennas in one, sharing the same radome, fixations and most of the same internal parts. It is engineered with upper-side lobe suppression and null filling. Polarization diversity, not spatial diversity, is used to reduce the effects of fading.

Circle (352) on Fast Fact Card



### Directional panel antennas serve PCS, WLAN

**Maxrad** expands its MP panel family with a new line of directional antennas for 800MHz/900MHz applications. The products, which feature a patent-pending printed circuit design and low-profile packaging, require no tuning. Model MP8066PT covers frequencies from 806MHz to 866MHz; model MP8246PT covers frequencies from 824MHz to 896MHz. Both models provide 6dBd of gain, 70° horizontal beamwidth and 60° vertical beamwidth. Model MP8906PT covers frequencies from 890MHz to 945MHz, providing 6dBd of gain, 70° horizontal beamwidth and 60° vertical beamwidth. Wideband model MP8068PT covers frequencies



from 806MHz to 960MHz with 8dBd of gain, 35° horizontal beamwidth and 65° vertical beamwidth. All models include a 12" RG-58/U pigtail and a choice of connector options.

Circle (353) on Fast Fact Card

### Dual-band units perform simultaneously

**Comet Antenna** has released two VHF/UHF dual-band vertical antennas that transmit on VHF or UHF, or on both simultaneously with the appropriate duplexer. The GP-9NC transmits at 153MHz-157MHz or 460MHz-470MHz, while the GP-9NCA transmits at 150MHz-154MHz or 460MHz-

470MHz. These high-gain, factory-pretuned antennas feature a low angle of radiation and are designed to withstand winds up to 90mph. On VHF, three stacked 5/8-waves provide 8.5dBi gain. On UHF, eight stacked 5/8-waves provide 11.9dBi gain.

Circle (354) on Fast Fact Card

### Base antennas minimize interference

**Radio Frequency Systems' Optimizer Plus** adjustable downtilt antenna builds on the patented process offered in the company's Optimizer products. With polarization diversity, fewer "plus" model antennas are required to cover a given area. Carriers can optimize system performance without service interruption. The continuous electrical downtilt feature and front-to-back ratio help minimize co-channel interference. The Optimizer Plus carries a five-year warranty.

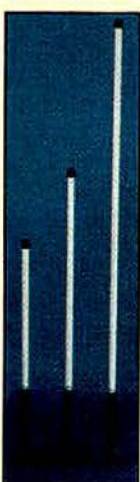
Circle (355) on Fast Fact Card



### Antennas feature tubular element

**Comtelco's** BSXL base antennas feature a tubular dipole element structure and a fiberglass radome. The antennas' aluminum bases are covered with a tough epoxy coating. They provide N connector termination and include a complete water drainage system. Most units in the series are available custom-tuned to the desired center frequency, from 45MHz to 2.5GHz.

Circle (356) on Fast Fact Card





## Alarm monitors automated systems



Zetron's model 1570 Sentridata is an ASCII alarm monitor that can add alarm and status reporting to new or existing control and management systems. The monitor connects to other vendors' equipment, such as building management systems, PBXs, process controllers or PLCs, and scans the data stream sent to the logging printer for specific messages or character sequence. When it detects a selected ASCII string, the monitor can follow programmed procedures and send alerts to a prioritized list of contacts by telephone, cellphone, pager or private radio. Telephone or private radio contacts receive a programmed voice message specifying the condition being reported. Pager users receive a specific test message relating to the alarm.

Circle (401) on Fast Fact Card

## READERS' CHOICE

Of the new products in the September 1999 Issue, this one generated the biggest reader response. For more information on this product, circle the corresponding Fast Fact number on the card found in the back of this issue, and mail the card to us.

## Digital radio camera stores nine images



The KVT-10 from Kenwood Communications is the company's newest model of digital radio camera, capable of sending images from one radio to another. This version has a custom-fitted, heavy-duty rubber boot to protect the camera's housing, making it suitable for outdoor use in public service, including police, fire, emergency and disaster management. The camera can store as many as nine digital images in JPEG format, can connect directly to popular models of portable radios and can send digital images to one or multiple recipients also equipped with a radio and KVT-10 unit. With its built-in mic and

speaker, the camera can be used simultaneously for voice and image communications.

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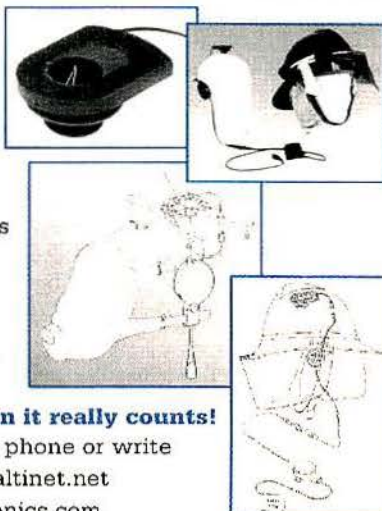
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Circle (51) on Fast Fact Card



## Digital recorder offers new versions



**JEI Communications Recorders** has introduced two-, four- and six-channel versions of its eight-channel digital recorder (the DVR-8). These new versions make digital recording available to organizations of smaller sizes and budgets. Just like the eight-channel version, the lower-channel versions have a built-in monitor and the capability to play the last recording with two keystrokes.

Circle (402) on Fast Fact Card

## Trunked portable accesses EDACS

**Com-Net Ericsson Critical Radio Systems' EDACS 300P**, a network-ready portable radio with the ability to roam between EDACS sites, offers the same access to EDACS that trunked radio users have had before. Public works, construction, transportation services, security and industrial customers will find that the small size and flexibility of the radio make it suitable for daily communications. Measuring a little more than five inches in height, the radio is ergonomically designed and easy to carry, while providing the basic features of trunking communications. The radio includes an emergency button, located on the top of the radio for quick, easy access and the highest priority transmission.

Circle (403) on Fast Fact Card

## Paging transmitter supports Flex operation

A DSP-based VHF paging infrastructure transmitter from **Sonik Technologies**, the PTX-150, is designed to meet the paging industry's standards for high-speed Flex and simulcast operation. It will operate with a range of standard network interfaces and is suited for new systems as well as for upgrading existing paging networks. This direct digital paging transmitter generates paging formats including POCSAG, Flex and ERMES. Standard output power is 100W continuous (adjustable 25W to 100W). Optional amplifiers are available with 250W and 500W output. As many as 16 channels



can be preset for multichannel operation over the 138MHz to 174MHz frequency range. For simulcast operation, the standard internal 1ppm TCXO may be supplemented by an external reference oscillator.

Circle (404) on Fast Fact Card

## Public safety software provides real-time data

Inform from **Vision Software** is a versatile, Web-based computing product designed for the public safety industry. This technology provides real-time, mission-critical application data to agencies nationwide. The software requires virtually no training, and it has minimal hardware and software requirements. With a browser and agency-assigned user rights, users can access data from almost any location with Internet access. It

works in conjunction with Vision Software's products by allowing users to view data originally entered in the Public Safety Suite. Users can also track personnel, make training schedules and deal with other personnel issues. Agencies can also maintain and update their standard operating procedures and policy and procedure manuals online in a central location.

Circle (405) on Fast Fact Card

## Gang charger kit houses six individual chargers



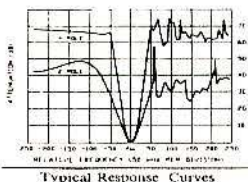
The ACC-405, a six-station gang charger kit, and the ACC-430, ACC-435 and ACC-440, all pre-assembled six-station gang chargers, are available from **Topaz3**. The ACC-405 kit is designed for easy assembly by the user and houses six individual Maxon chargers of the QPA-1130, QPA-1135 or ACC-400 types. The chargers are sold separately

and are compatible with Maxon portable models, including the SP-120 series, SP-130/SP-140 series, SP-150U and two new series: the SP-200s and SP-300s. Pre-assembled six-station gang chargers are also available configured with these charger models, bringing multi-unit charging capability to heavy radio users. The ACC-430 is assembled with six units of the QPA-1130 dual-slot, dual-rate smart charger. The ACC-435 is put together with six units of the QPA-1135 single-unit pedestal charger.

Circle (406) on Fast Fact Card

## The Filter Solution for Adjacent Channel SMR/ESMR Interference

The Piezo Technology 2133 (2-pole) and 4133 (4-pole) front-end crystal filters have been the industry benchmark for performance and value for over 20-years. With the increasing deployment of wireless communications and paging systems, they are more important than ever in insuring the quality and integrity of your SMR/ESMR systems. (25MHz to 220MHz licensed frequency)



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Each filter manufactured is custom tailored to your specific licensed frequency. Thereby, insuring that you maximize system performance. The filters are generally available on 3-5 weeks notice and can be ordered either factory direct or through PTI's growing list of distributors of SMR/ESMR radios or their service organizations.

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Circle (52) on Fast Fact Card



## Synthesized receiver complies with NTIA

DTC's NTIA-compliant synthesized receiver, the Minimate, is rugged and compact. The 10-channel receiver, Sony Mini-disc recorder, batteries and controls are mounted on a 0.25" piece of aluminum, covered with a lexan overlay and packaged in a watertight Pelican case. It features 10 user-programmable frequencies (8MHz spread from 138MHz to 174MHz) and 10 switch-selectable channels. It has wideband (25kHz) or narrowband (12.5kHz) channel spacing. The frequency stability is  $\pm 2.5$ ppm at 12.5kHz.

Circle (407) on Fast Fact Card



## Trunked portable supports SMR, ESMR

The model IC-F4TR trunked radio from Icom is for UHF SMR and ESMR operations. Conventional operation, basic LTR and Passport protocols are all built-in, offering the user a complete upgrade path as the system grows. Flash memory enables the easy addition of future system enhancements. Three bandwidth versions (400MHz-430MHz, 450MHz-490MHz and 480MHz-512MHz frequencies) have switchable 12.5kHz/25kHz channel width, and 5kHz/6.25kHz frequency pitch, making the new UHF channels available for trunking. The eight-digit LCD has 18 icons that indicate system status and operational selections, including battery condition. Each version has seven PC programmable keys, which can be assigned functions to customize operations for end-users. The radio also features a 4W output with the standard battery.

Circle (408) on Fast Fact Card



## Data network system adds security feature

Motorola's Global Marketing and Sales Group has released a new system for its Private DataTac 2.0 wireless data network product, version 2.03, that adds system security and performance monitoring enhancements. The system also offers data rate-agile modem capabilities, a feature suitable to public safety users who use 806MHz and the narrower 821MHz band. The program features user authentication that requires an

authorized identification and password to gain network access, over-the-air message encryption and encryption key management. Security features are supported for Internet protocol and formatted logical messaging-based applications. These two connectivity choices provide an industry-standard interface, as well as a Motorola application program interface that is suited for wireless data communications.

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## Headset speaker station allows mobility



The amplified headset speaker station (P/N 40690G-01) from **David Clark** allows for the ampli-

fication of mobile radios to remote locations and is designed for use with or without headsets. It is built with a connection for optional use of a series 3000 noise-attenuating headset and a C-3109 push-to-talk belt station with a 15-foot coil cord. The headset speaker station can be mounted on the pump panel of a fire engine, or it can be used for any application that requires radio audio to be heard at a distance from the radio's mounted location.

Circle (410) on Fast Fact Card

## Batteries work with Motorola radios

**Alexander Technologies'** H7395 and H7394 are replacement batteries for Motorola's Visar two-way radios. The H7395 is a NiCd 7.5V replacement rated at 1,200mAh. The H7394 is a NiMH battery rated at 1,600mAh. The batteries incorporate a metal latch to prevent latch breakage. The batteries use high-quality cells, have ultrasonically sealed, high-impact housings and are precision-matched for color, texture and fit.

Circle (411) on Fast Fact Card



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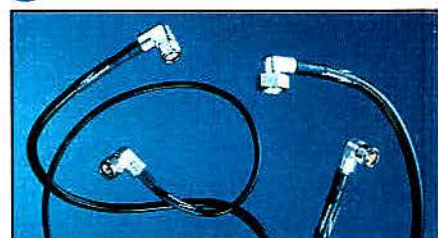
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Circle (49) on Fast Fact Card

## Connectors feature good return loss



**Andrew's** factory-installed, right-angle connectors for its Sureflex cable assemblies give the performance of a straight connector with the mechanical advantages of a right-angle connector. In factory tests, Sureflex 1/2-inch cable assemblies with right-angle connectors are providing return loss of 28dB or better at frequencies as high as 2.5GHz. The right-angle connectors are available on Sureflex cable assemblies for 1/2-, 3/8- and 1/4-inch Heliast superflexible foam dielectric cable.

Circle (412) on Fast Fact Card

## CAD system offers redundant operations

The **Cross Current** system (ccCAD) automates and combines the key functions of communications center personnel for law enforcement, fire, emergency medical service and other agencies. It is a 32-bit application and was created for Microsoft Windows NT. It provides redundant operations with high availability data access (no single point of failure). The unlimited growth path and flexibility allows you to use the current technology and future technology developments. It reduces training time and expenses and offers integration with other systems. Hardware and software scalability allow for growth. Commercial off-the-shelf applications can be added.

Circle (413) on Fast Fact Card



## Connector line offers plugs for low-loss cables



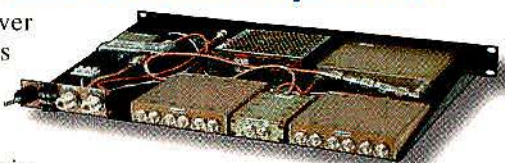
chined brass bodies and Teflon insulation. All metal components are silver-plated for intermodulation considerations. The RFD-1631-2L2 works with LMR-600 and Ultraflex cables from Times Microwave and BWC-600 and BWC-600R cables from CommScope. Other 7/16 DIN styles developed for these 0.60" diameter cables include straight or combination versions of male clamp or crimp plugs, and female clamp and crimp jacks in straight or combination configurations. A range of connectors is available for these and all other sizes of low-loss coaxial cables.

Circle (414) on Fast Fact Card

**RF Connectors** has expanded its 7/16 DIN connector line to include plugs and jacks for larger diameter, low-loss cables manufactured by Times Microwave, CommScope, Belden and Amphenol. The 7/16 DIN connectors feature ma-

## Multicoupler features 12-channel expansion

The 42-05-01-XX compact receiver multicoupler from **TX RX Systems** is for use in the 100MHz to 512MHz frequency range. Models covering the entire frequency range are available in 12 to 24 channels, expandable in 12-channel increments. Other features are 3.6dB noise figure and 13.5dB of net gain. It features less than 1.2:1 output



VSWR and BNC or type N connectors. Unused ports do not need terminations.

Circle (415) on Fast Fact Card

## Desoldering stations offer thermal reliability



**Pace's** ST 75 and ST 115 desoldering stations deliver tip temperature reliability and vacuum performance in a small package. These stations are fully self-contained. The ST 75 has analog control and manual temperature lock-out. The ST 115 offers digital LCD, auto tem-

perature setback, auto tip-offset compensation and password lock-out. These units are ESD safe, feature auto-off safety systems and have modular stacking capabilities for limited workspace. Both units use the same Quiet Flo pump and Auto-snap Vac features, which decrease clogging and maximize heater and tip life. These systems come standard with the SX-70 desoldering handpiece and can be matched with any of the Sensatemp handpieces, including the PS-80 soldering iron.

Circle (416) on Fast Fact Card

## System offers call-taking, incident response

**Positron's** Power 911 Lite is an integrated intelligent workstation for 9-1-1 call takers, dispatchers and supervisors. The system's open architecture operates through a Microsoft Windows graphical user interface and can run on a variety of PC platforms. The system places computer telephony tools, user screens and database interfaces at the call-taker's fingertips. The system is intuitive and dynamic, presenting the call-taker with interactive prompting, notification of database modifications and data networking. It can be customized to meet specific PSAP requirements. It is suitable for small 9-1-1 call center applica-

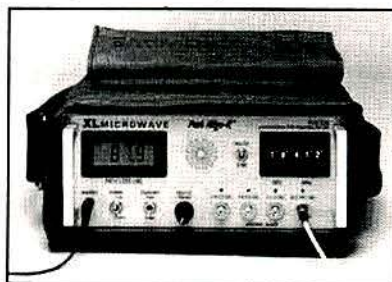


tions. The product features incident detailing, ANI and ALI, call detail tool bar, and call and incident lists.

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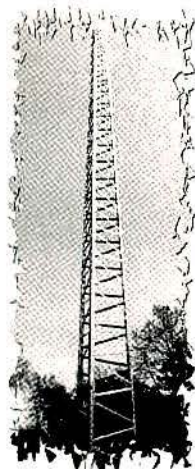
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**Alan Haase**, vice president of Terrestrial Microwave Products at Andrew, Orland Park, IL, advances to group president of Communication Products.

Promotions at Anritsu, Richardson, TX:

**Bill Lovelace**, president of Anritsu's North American Region Operation (NARO), moves up to general manager of the International Sales Management Center (ISMC). **Phil Bowen**, general manager of NARO, takes Lovelace's place as president of NARO.

**Bill Rose**, vice president of Electronic Engineering at Leviton Manufacturing, Little Neck, NY, becomes chairman of the Arlington, VA-based Consumer Electronics Association's Technology and Standards Council.

**Jo-Anne Basil**, vice president for external and industry relations at the Cellular Telecommunications Industry Association, Washington, represents CTIA on the Center for the Study of Wireless Electromagnetic Compatibility's Industry Advisory Board, located at the University of Oklahoma.

**Rick Guipe**, senior vice president of Wireless Network Systems at TESSCO Technologies, Hunt Valley, MD, joins the board of directors of the Wireless Communications Association, Washington.

**Richard C. Notebaert**, retired chairman of Ameritech, Chicago, joins Lisle, IL-based Tellabs' board of directors.

Appointments to Montreal-based Microcell Telecommunications' board of directors:

**Bruno Ducharme**, president of Telesystem International Wireless, Montreal, joins the board, as well as **John W. Stanton**, chairman of VoiceStream Wireless, Albuquerque, NM, and **Robert R. Stapleton**, president of VoiceStream.

**David Neylon**, former chief operating officer of LookSmart, San Francisco, becomes chairman of the board at Geoworks, Alameda, CA.

**Armineh Noravian** departs E/O Networks, Mountain View, CA, as engineering vice president to join Larus, San Jose, CA, as vice president of development engineering of its research and development facility, Vista Labs.

**Doug Garber** departs GTE Public Safety, Dallas, as senior product manager for public safety systems to join Global Dispatch Technology, Oklahoma City, OK, as vice president of sales.





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## City of Tucson Communications/ Electronics Technician Department of Operations Position Opens April 28, 2000 Position Closes May 29, 2000

This highly skilled technical work involves maintaining, repairing, troubleshooting, installing, modifying and testing analog and digital communications systems, including local government broadcast FM, point-to-point, SCADA microwave communications and related electronic equipment. Work is subject to 24-hour, on-call status and shift assignment. Salary: \$17.53 hourly. Applications are available at City Hall Annex, 110 E. Pennington, Third Floor. Applications may also be obtained by writing to City of Tucson/ Human Resources, P.O. Box 27210, Tucson, AZ 85726-7210. For further information, call (520)791-4241. **Affirmative Action Employer**

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**Desirable Knowledge and skills:** Considerable knowledge of the hardware and software requirements of various systems. Knowledge of the federal, state, and local regulations pertaining to the generation and transmission of radio signals. Ability to express ideas clearly and concisely, both orally and in writing.

**Minimum Training:** Bachelors degree in electrical communications engineering, business, public administration or other appropriately related field. Two years experience in administering and managing a radio, telephone, or electronic system. Additional qualifying work experience may be substituted on a year for year basis for the required college education.

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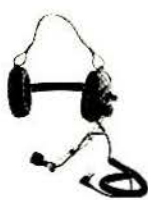
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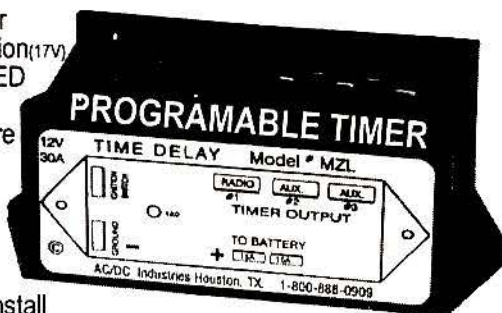
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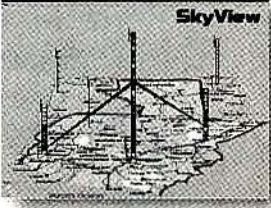


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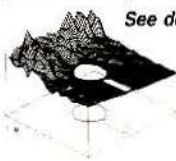
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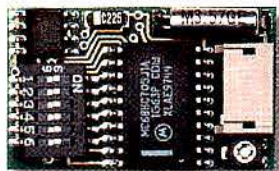
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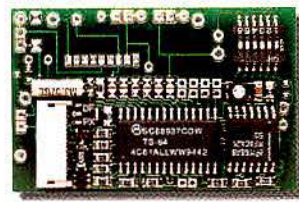




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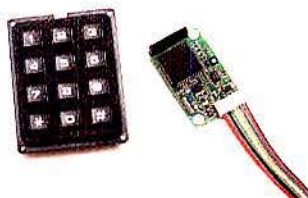
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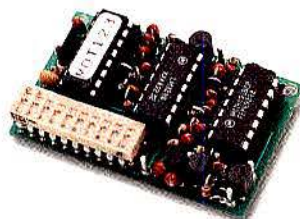
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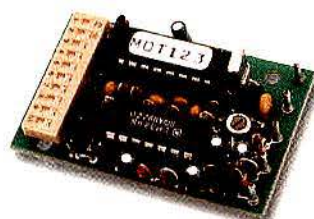
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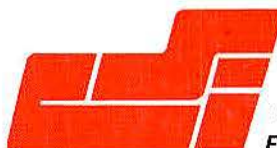


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